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CONTENTS

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IN THIS ISSUE

PUBLIC health workers have long regarded epidemiology as the basic science of preventive medicine and public health. The present heartening enthusiasm for improved and expanded mental health programs makes the epidemiology of mental disorders a research topic of ever-increasing importance and urgency.

In the nine years since the publication of Robert H. Felix and R. V. Bowers' "Mental Hygiene and Socio-Environmental Factors,"[1] the volume of studies on the epidemiology of mental disorders has grown from an occasional trickle to a thin stream. The Fund's monograph on the EPIDEMIOLOGY OF MENTAL DISORDERS, now regretfully out of print, has helped, it is hoped, to stimulate this stream to grow. Progress in this type of research can be gauged somewhat by the fact that it is probably already out of date. The roundtable discussion which that monograph reported addressed itself largely to the question: "Can mental disorders be studied epidemiologically?" The answer was, in some detail, "Yes." Today the thin stream of reports which occurs in the psychiatric, sociological, psychological, anthropological, and public health literature provides a rich substantiation of that answer and many examples of good studies on inadequately formulated questions, inadequate studies on well-formulated problems, and occasionally well-conducted studies on soluble problems. Today, then, the outstanding questions in this field are: (1) What are the best technical means of avoiding common errors in organizing and conducting studies on the epidemiology of mental disorders? (2) How can problems regarding the epidemiology of mental disorders be best formulated as questions suitable for investigation?

[1] The Milbank Memorial Fund *Quarterly*, XXVI, No. 2, April, 1948, pp. 125–147.

The article on "The Epidemiology of Mental Disorders" in this issue, by Dr. Ernest M. Gruenberg of the Technical Staff of the Fund, is the text of an address on the second of these questions, delivered before a Technical Session of the Annual Conference of the World Federation for Mental Health which was held in Berlin in August, 1956. Dr. Gruenberg describes the current types of study being reported and offers a tentative classification of the problems to which the growing literature addresses itself. The list of references provides a sampling of basic and current publications in this field.

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Changes in caries rates for the permanent dentition of Norwegian school children during and after World War II are described in the second section of a report from an investigation conducted by the Norwegian State Dental School from 1940 to 1953 which is published in this issue of the *Quarterly*. Dr. Guttorm Toverud, Professor of Pedodontia at the State Dental School, who directed the study and analyzed the data, is presenting the findings in "The Influence of War and Post-War Conditions on the Teeth of Norwegian School Children." This second report "Caries in the Permanent Teeth of Children 7–8 and 12–13 Years Old" presents the data on trends over the 13-year period in caries rates for all erupted teeth and for individual teeth among children in cities, villages and rural districts. In later sections, patterns of change in the amount of caries in specific teeth will be described and results of the investigation will be discussed more extensively.

The present report gives evidence of very striking reductions in the occurrence of caries during the war years which were common to school children in urban and rural communities. The downward trend in rates came to a halt at the end of the war or soon after, and reversal of the trend became apparent within a few years in most communities. Increases in caries rates have varied in different communities, but, except in a very few communities, rates in 1952–1953 had not reached the levels of 1940–1941.

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Records of mortality in the United States in the 19th Century are very limited and data for Massachusetts usually have been utilized to describe the mortality experience of that period. For 1850, mortality data are available for Maryland, and by combining the Maryland and Massuchusetts data, Paul H. Jacobson, Supervising Statistical Analyst of the Metropolitan Life Insurance Company, has constructed a new life table that is more representative of the country in 1850. This life table is presented in "An Estimate of the Expectation of Life in the United States in 1850."

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The results from an ingeniously designed and well-executed study appear in the article "Are Sex Mortality Differentials Biologically Caused?" by Francis C. Madigan, S.J., of the University of North Carolina. In order to provide some evidence on the question posed, the author and his colleagues, undertook to study "a male group and a female group in which cultural stresses and strains had been so standardized between sexes that one could observe the operation of biological factors in comparative isolation. . . . The subjects chosen for study were teachers and personnel of administrative staffs of Roman Catholic religious Brotherhoods and Sisterhoods engaged in educational work." The period covered was 1900 to 1954.

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In a "Note on Birth and Death Registration of Military Dependents," Robert N. Bishop, Statistician of the Tacoma-Pierce County Health Department, Washington, calls attention to inaccuracies in infant death rates and birth rates that may arise from practices of recording place of residence on certificates of birth and of death of infants of members of the armed forces.

EPIDEMIOLOGY OF MENTAL DISORDERS[1]

ERNEST M. GRUENBERG, M.D., DR. P. H.[2]

THE mental health movement is concerned with several different things and consists of a number of different parts. One concern, for example, is with the general welfare of children and the improvement of children's opportunities for personality development, education, and general happiness. Another part of the mental health movement is concerned with the prevention of mental diseases.

In my mind, and in this talk, these two parts of mental health work are different. What I will discuss with you today has to do only with the prevention of mental diseases. The conscious prevention of disease is accomplished when we knowingly change people's conditions of life so as to reduce the likelihood of their becoming sick. This may be done for the individual either by decreasing his tendency to react to life in pathological ways or by removing him from circumstances which tend to produce pathological reactions. For groups of people, prevention can also pursue either of these courses: groups of people can be changed so as to reduce the likelihood of a pathological reaction or, through social action, the conditions of living can be so changed that conditions which produce disorder are eliminated or made less common.

The situation regarding the prevention of mental diseases contrasts with the situation regarding the prevention of physical diseases. Millions of people die prematurely because of a failure to put knowledge to work through strong government and voluntary public health programs. We suffer because the public health movement is not as strong as its knowledge and techniques. The mental health movement, in contrast, is stronger than its knowledge. There is a readiness for mental health programs and a willingness of government to pay for

[1] Address at the Annual Meeting of the World Federation for Mental Health, Berlin, August 14, 1956.

[2] Milbank Memorial Fund.

mental health programs capable of mobilizing greater resources than are needed to prevent those few mental diseases we know how to prevent. We suffer from a shortage of established techniques for the prevention of disease. We suffer from a shortage of knowledge regarding the circumstances which favor the development of mental disorders. Our colleagues who concern themselves with physical public health, see that increased life expectancy and freedom from preventable disease could be achieved for all people if only we could find ways of bringing public health techniques to bear on every community. They, too, would like more knowledge: they would like to know how to prevent cancer, the common cold, arteriosclerosis. We who are interested in mental public health wish we had established mental health techniques with which to arm the existing mental health movement, both the voluntary associations and the government agencies. We, too, would like to see more widespread and vigorous mental health movements in more communities. Both groups need more techniques and more organized health movements. But the main problem for those concerned with physical health is the development of organizations and administration, while our main problem is the development of knowledge and techniques for the control of disease in populations.

To prevent disease one must know what changes need to be made. This means that one must know what states of the organism are likely to react pathologically and what conditions of life are likely to produce pathological reactions. To get this knowledge one must find out what kind of people develop pathological reactions and what circumstances favor the development of pathological reactions. This means that we must understand the distribution of diseases in populations. The study of the distribution of diseases in populations is called epidemiology. Because preventive work depends on this kind of knowledge, epidemiology has been correctly called the basic science of preventive medicine. What I wish to discuss with you then, is the basic science of preventive psychiatry.

It might seem to some of you that using the name "epidemiology" to describe this field of research makes obscure what would otherwise be very clear. I do not myself, think that it helps very much and there is a danger that a new combination of words encourages magical thinking instead of common sense. But I think it does help to recognize that the basic science of preventive psychiatry is epidemiology because then we can learn something from epidemiologists—we can use the experience gained in studying the epidemiology of nonpsychiatric conditions in tackling our own problems. It may help those unfamiliar with this public health term to realize that it comes from the Greek term meaning "upon the people." This root gives us the word "epidemic" which refers to a disease suddenly imposed on a people. It also gives us the term "epidemiology" which is the study of the patterns of occurrence of disease among the people. Explosive epidemics is only one such pattern of occurrence; endemic diseases common to a large proportion of a population is another pattern. Epidemiologists have developed rather refined techniques for characterizing the patterns of occurrence of various diseases in populations. I believe that epidemiologists have a contribution to make to mental health work and a few are beginning to show some interest in making their contribution.

We sometimes forget that mental health programs always make epidemiological assumptions. For example, if a preventive program calls for the home delivery of babies whenever possible in order to strengthen the relations between mother and child, and calls for this in the name of prevention, this program assumes that children born at home will have fewer of certain mental disorders than children born in hospital. If we ask what the evidence for this assumption is we will find no direct evidence at all. Instead, we find a series of inferences based on clinical experience with sick children and adults, elaborated in the framework of some general theories of personality development, family relationships and the conditions favoring mental disorders. The facts themselves are open to

suspicion, the inferences do not flow with watertight logic from the supposed facts, and the general theories are more a fashion than established knowledge. This does not mean that the assumption is wrong in fact. It does not mean that the program is a bad program. It means we do not know, and that we need more information before we can be sure. If we were to try to find out whether children born at home had a lower frequency of mental disorders than children born in hospital, we would have to make an epidemiological study. This could be done with our present technical skills, but it has not been done yet.

The same can be said about most mental health preventive programs. Whenever we undertake to prevent disorder we assume we know the conditions which favor the disorder and the conditions which make it unlikely to occur. If we wish to make our programs effective we will need much more information than we now have as to what those conditions are.

In this talk I am going to speak first about epidemic phenomena in psychiatry. Later I will speak about mental disorders which are related to special events. After that I will discuss some of the work which suggests that the distribution of certain mental disorders is affected by the general environment in which a population lives. I take it for granted that these matters are of importance to those who are interested in preventing mental disorders.

Some of the disorders of mental life have the characteristics of outbreaks, of mass disorders, of herd pathology, of epidemics. One such was described by J. F. C. Hecker (1) as "Die Tanzwuth, Eine Volkskrankheit im Mittelalter." These dancing manias have a particular value in this discussion because they were mass illnesses of a particular time and place, had a seasonal distribution, and were of a definitely epidemic nature. They were well recorded both by physicians and other observers. Sigerist (2) abstracts contemporary description as follows:

> The disease occurred at the height of the summer heat, in

July and August, and particularly during the dog days. People, asleep or awake, would suddenly jump up, feeling an acute pain like the sting of a bee. Some saw the spider, others did not, but they knew that it must be the tarantula. They ran out of the house into the street, to the market place, dancing in great excitement. Soon they were joined by others who like them had just been bitten, or by people who had been stung in previous years, for the disease was never quite cured. The poison remained in the body and was reactivated every year by the heat of summer. People were known to have relapsed every summer for thirty years . . .

Thus groups of patients would gather, dancing wildly in the queerest attire. "Sometimes their fancy leads them to rich clothes, curious vests and necklaces and suchlike ornaments [reported Baglivi]. They are most delighted with clothes of a gay color, for the most part red, green and yellow. On the other hand, they cannot endure black; the very sight of it sets them asighing and if any of those that stand about them are clad in that color, they are ready to beat them and bid them be gone." Others would tear their clothes and show their nakedness, losing all sense of modesty. . . . Some called for swords and acted like fencers, others for whips and beat each other. Women called for mirrors, sighed and howled, making indecent motions. Some of them had still stranger fancies, liked to be tossed in the air, dug holes in the ground and rolled themselves in the dirt like swine. They all drank wine plentifully and sang and talked like drunken people. And all the while they danced and danced madly to the sound of music.

Music and dancing were the only effective remedies, and people were known to have died within an hour or a few days because music was not available. A member of Dr. Ferdinandus' own family, his cousin Francesco Franco, died thus within 24 hours because no musician could be found after he had been stung.

Sigerist has shown that this epidemic illness of the past can be analyzed retrospectively and that hypothetical explanations of the outbreaks may be constructed from the existing records. The advantage of discussing a disease which has not

occurred in the last hundred years, is that it impresses on us the fact that mental disorders change with time, that they are changeable; the disadvantage of discussing a disease unknown for the past century is that no one in the room has seen a case and no modern psychiatric examinations were made. For this reason I will not describe these fascinating outbreaks further. However, the great epidemiologist Hecker also dealt briefly with other mass phenomena, particularly the convulsionaires and the epidemics of fainting which occurred in a number of settings. Bechterew (3) also described many similar epidemics in his monograph of 1905. Epidemic outbreaks of fainting and other phenomena still occur and can be studied. For example, Kräupl Taylor (4) recently described an outbreak of delusional thinking on a ward at the Maudsley Hospital, London. An outbreak of suicide was reported from Paris a few years ago. In the United States an outbreak of hysterical paralysis with delusions of poisoning occurred during the early years of the Second World War. (5) And we must not forget the possibility that some of the events at Lourdes and some of the fashions in medical treatments, as described by Penrose, (6) may well be capable of the same kind of analysis.

A more modern form of group psychopathology occurs in household outbreaks. I use the term household outbreaks here to avoid assumptions implied in the clinical terms "folie à deux," "folie communiquée," "folie simultanée," and folie imposée." It is perhaps of interest that our clinical terms for these small-scale outbreaks are all French and derive from descriptions of groups of cases which appeared in the French literature during the 19th century. This is not the place to enter into a description of the types of disorder and patterns of relationships which occur in these outbreaks. Examples occur from time to time and are reported in the literature. There is reason to believe that many more instances occur than are reported. Etiological explanations and treatment programs are not agreed upon by clinicians. In fact, the ideas about mental disorders which dominate clinical work make it hard to account

for these cases, since the symptomatic disorder is generally regarded as a product of the patient's history—that is either by the nature of the genes which combined at the time of conception or of his later physical or interpersonal history. In fact, many clinical psychiatrists resist the idea of an epidemiology of mental disorders because they wrongly believe that epidemiology deals only with epidemics, and absolutely wrongly believe that epidemics of mental disorder do not occur. The whole history of mankind to the contrary notwithstanding, there is a tendency to think that ideas, attitudes, ways of thinking, and patterns of behavior are not communicable from man to man! There is also an unwillingness to give full recognition to the obvious fact that no man develops an idea, an attitude, or a pattern of action all by himself with no help from anyone else—that these things are developed within groups of people and within cultures, sometimes very special and small intimate cultures. It is striking that in many of the case reports in the literature of household outbreaks different members of the epidemics receive different diagnoses by the psychiatrists. It is important to ask, when this happens, what relationship the diagnosis has to the disturbance for which the patient is seen clinically. Many reports imply that only one of the group was really sick and that the others only appear to be sick, or have their sickness (or its appearance) "imposed" on them by the primary case. In reading over these case reports I have often been led to ask myself whether the "primary" case would have become disturbed if he had been living with different associates.

The function of suggestion in mental illness requires much more extensive investigation, not only because we need to understand the epidemics of mental disorder referred to above, but for other reasons as well. The role of suggestion in hypnosis is in a way obvious. Its role in other forms of psychotherapy is also often clear—sometimes clearer to outsiders than to the psychotherapist! A more subtle form of suggestion exercised by psychiatric facilities is well described by Cam-

eron in the following discussion of open and closed psychiatric hospitals, which obviously derives from Pinel:

> Those who have worked both in maximum-security, locked hospitals and in open hospitals can have little doubt that many of the more difficult problems are created by the methods used in handling patients. Throughout the entire life of an individual, society is actively engaged in rendering that individual as responsive as possible to the restraints and the imperatives imposed by his group: capacities for experiencing guilt and shame, capacities for responding to motivations, longings for conformity and acceptance are set up in everyone with the greatest assiduity from the time he is born, and this process is continued throughout his whole life. If an individual, thus heavily conditioned to respond to the anticipations of his group, is reset in a closed, maximal-security hospital, then all his surroundings — the stripped-down room, the protected window, the innocuous cutlery, the counting-in and counting-out, the continuously watching attendant and nurse — all must conspire to convey to the patient the anticipation that what the group now expects of him is uncontrolled, irresponsible, impulsive, and destructive behavior. And, as is well known, this often is just precisely what happens. (7)

It is clear that such ideas, patterns of thinking, patterns of behavior, attitudes and what is often called "defense mechanisms" may be transmitted through suggestion and spread through groups. Only the most primitive types of studies have been done on this kind of phenomenon, athough the literature is fairly extensive. It is important to realize that an understanding of the conditions under which healthy and unhealthy patterns are transmitted and gain currency would be of enormous values even if one remained powerless to change the distribution of diagnoses in a population. The diagnosis in itself is often not disabling, but the behavior or thought pattern can be. As Pinel showed long ago, and others are showing every day in the best mental hospitals, people with serious diseases can either be encouraged to have symptoms destructive to themselves or others or encouraged to live relatively undis-

turbed and useful lives. Undue preoccupation with the diagnosis blinds us to a recognition of what is modifiable in behavior and mode of functioning. At the present time I can see no reason for assuming that attitudes, ideas, thinking patterns, and behavior patterns are transmitted to and among mentally ill persons by different means, or according to different laws of interpersonal relations than the same things are transmitted among people who are not mentally ill. I believe that it will be fruitful for future research to follow the dictum of Albrecht Haller which was used by Virchow: *Pathologia physiologiam illustrat.* (8)

Another pattern of occurrence of mental disorders which has been successfully investigated, to a limited extent, has to do with previous special events in the life of the organism. I would like to cite two examples of this type of research, of which much more is needed. Pasamanick, Lilienfeld and Knoblock (9) have shown that there is a relationship between certain complications of pregnancy and mental deficiency and behavioral disturbances. Since the relationship between rubella during pregnancy and congenital malformations was discovered by Gregg (10) there has been much speculation regarding other insults during fetal life which could permanently affect brain development without causing death. Available evidence suggests strongly that there are a wide variety of such insults —malnutrition, temporary anoxia, trauma, intercurrent infections, metabolic disorders—which may have such effects. The nature of the insult is not apparently relevant while the stage of development of the fetus appears more important. The effects on intellectual development, emotional stability and so forth require further investigation. However, the work done so far in epidemiology by Pasamanick and his colleagues and on experimental teratology by Ingals, are of prime importance for two reasons: first, they open up new vistas for the prevention of various forms of congenital brain disorders and second because they are fine examples of how such studies may be carried out.

Bowlby's (11) summary of the evidence regarding institutionalized children is, of course, known to all of you. This work, and those which have followed it, contain a number of epidemiological hypotheses which need further investigation. One such hypothesis is stated by Lauretta Bender in an article titled "There is No Substitute for Family Life." (12) She says that children can only learn to have deep affectionate ties during the first years of life and can only learn this by reflecting the affection emanating from a continuing nurturant mother figure within the framework of family life. Only through the pattern set up by families can children learn to regulate their daily lives, acquire a sense of time and of timeliness, of space and of personal identities. Only with such an armamentarium can a child govern his feelings and behavior by a concept of the future and of future relationships. This is a credible and testable hypothesis. Although it is difficult to unravel all the intriguing side issues—such as what is the consequence of *bad* (that is, disorganized, nonaffectionate) family life—this can be done.

Some workers have related the findings on the primary psychopath who has been deprived of familial upbringing during his early years, to the presumed effect of abrupt and disturbing separations from a loving mother and an affectionate home. This is dramatized in the film by Bowlby and Robertson "A Two-Year-Old Goes to the Hospital." Hospital separations from mother are often unnecessarily disturbing to children; this is an undoubtable fact for anyone who looks around him. Separations can be made less disturbing; this is obvious to anyone with imagination. They should be made less disturbing by all possible means; this is obvious to anyone with any human sympathy. The effect of disturbing separations from mother is permanent, serious and later disabling; this proposition is credible and testable. We should know. We do not know. We know how to find out.

Some mental health moralists have found encouragement in the Bowlby monograph for the belief that mothers should

be enslaved by young children and ought not to leave young children with sitters while they go to the movies. This viewpoint is not supported by any studies cited by Bowlby but is supported by certain professional attitudes of hostility towards mothers and by ideas that children are and should be incapable of having any affectionate relations with anyone else. It is also supported by feelings of inadequacy and guilt in many young mothers. As a part of mental health programs it is completely unsupported by evidence of harmful effects following such separations of mother and child. Since we are ignorant of the facts it is not possible to say that leaving young children for an evening or a weekend is unrelated to later mental disorders. We do not know whether or not this is the case. It is possible, however, to be reasonably suspicious of the idea, since it is so obviously a product of certain social trends which see women's role defined by the phrase "*Kinder, Kirche und Küche.*"

If we believe that treatment programs sometimes improve community mental health, we make the same kind of assumptions and these assumptions may be tested by the same epidemiological methods. Instead of the belief that prenatal damage leads to mental deficiency, or the assumption that lack of a primary mother relationship leads to primary psychopathy, we focus on the belief that a sick population provided with a certain treatment will have less pathology than another equally sick population not exposed to this treatment. The methods of research are the same and the findings can be of great importance. Professor Paul Hoch has recently pointed out that the disability suffered by epileptics and diabetics can be greatly reduced by the suppression of symptoms. Even when we cannot prevent the occurrence of disease we can sometimes develop techniques for the control of the most destructive symptoms. Dr. Hoch suggests that this may turn out to be the case for some forms of chronic schizophrenia when treated with the so-called tranquilizing drugs. It is also reasonable to hope that the systematic provision of re-education for

community living can reduce the disability suffered by people with various chronic psychoses and character disorders.

The effect of the environment on the distribution of various mental disorders has been the subject of a few studies, but of even more speculation.

There are two simple and important ways of sorting populations so as to compare the occurrence of different forms of pathology. One is by sex and the other is by age. In the extreme form observations regarding the differential distribution of disorders state that a form of pathology known to occur in one population does not occur in another population. Thus some have said that hysteria is confined to females. This, however, we know not to be true. Schizophrenia was thought for a time to be characteristic of certain age periods; but this is now open to doubt. These extreme distributions are, of course, of enormous value if well established since they would give us crucial information on the situations which favor the development of pathology. Intercultural studies would be of great value if they were of a high enough quality to yield reliable information. To know that going amok only occurs in certain populations would be very valuable if first, we knew it to be true, and second, we knew just what form of pathology it represented. A clear understanding of the clinical condition is necessary to know what it is which has this peculiar distribution. But it is also needed if we are to know that the peculiar distribution occurs, since without a clear clinical picture we cannot know whether the same or similar forms of disorder do occur in other cultures. Another difficulty—which certainly can be overcome—has to do with the application of the same criteria in different cultures. Those who are seeking for cases in two different cultures must be equally familiar with the two cultures and be able to recognize that informants in two different cultures may react differently to the same disorder and so provide the investigator with information of unequal intensity regarding the presence of the disorder. It is not necessary to go to the far ends of the earth or to primitive cultures

to gain experience with this kind of variation. Tietze gives an instructive illustration from the attempts to study the prevalence of disorders in Baltimore over a period of years. In the first survey, more cases were found in men than in the second survey, which occurred in 1936. Tietze attributes this to a changing attitude on the part of informants. In the earlier survey the informants assumed there must be something wrong with all men who were unemployed, and found psychopathological explanations to their own and the investigators' satisfaction. By 1936, however, the informants began to realize that unemployment could have other than psychopathological causes and no longer saw the unemployed men as having something wrong with them. (13) Variation by age and sex presents the same problem. The more one studies the puzzling distribution by age of mental retardation (14), the more clearly one will see that we do not have the same definition of mental deficiency for different age groups and that we have not yet done the necessary job of defining mental retardation in terms equally applicable to all age groups. The same may be said for schizophrenia, involutional melancholia, reactive depressions, and a number of other syndromes. Suicide, which is easier to define so that it may be studied equally intensely in both sexes and at different ages shows some marked regular patterns with age and sex. Although the studies of Durkheim, Halbwachs, Sainsbury, and Murphy on variations in suicide rate by different social groups have received more attention, it is highly worthwhile to pay careful attention to variations by age and sex.

Variations by social class are currently receiving increasing interest in the United States. The prevalence of a number of pathological states in different class groups has been shown to be higher in populations with lower socio-economic status. Schizophrenia in Chicago, Providence, New Haven, Buffalo, and other places has been shown to have this overall pattern by various methods of study. Alexander Leighton and the late Thomas Rennie have both shown such variations to be true of

a large number of symptoms, one in a small village and the other in a large metropolitan area. The studies with which I have been associated in Syracuse have shown a similar pattern for psychoses among people over 65. (15) Studies in Syracuse have also tended to show a higher prevalence of reported mental deficiency in the most economically and socially depressed section of the City. Sainsbury's recent London Studies on suicide, Murphy's studies in Singapore, Sundby's and Ødegaard's studies in Norway, and others have shown variations with various features of the social environment. (16)

It is important to recognize that this pattern does not hold for all forms of illness. It does appear to be the case for some. Such general relations, while they do not give us detailed insight into the mechanism by which disorders develop are useful. They help to give us perspective in interpreting other more detailed studies. They also help to provide some orientation regarding prevention programs.

Illnesses of populations, we have seen, may be studied in terms of relationship between cases, in terms of a common previous experience, and in terms of disease distribution in different populations. This classification of relationships is not suggested as of fundamental importance, but simply as a convenience for the present discussion. Without going into detail I have assumed the privilege of referring to schizophrenia, suicide, hysteria, mental deficiency, and other categories of pathology as if they were all equally good objects for epidemiological investigation. It seems to me that they are. These terms refer to different disordered states or to different features of disordered states and the basic principles of epidemiological study are equally applicable to all of them. On the other hand, each has a different meaning and epidemiological knowledge has different values depending on what we have studied. It is not always easy to relate epidemiological findings to clinical or theoretical problems. There is a certain amount of luck involved in acquiring bits of information which fall into a pattern as soon as they are acquired. Because the

field of mental health is so broad and is at such an early stage of development, it may be worthwhile to sketch out a general framework for relating various forms of pathology to one another.

First, we would like to be very scientific and concentrate on etiologically defined disease entities. Such studies are useful in the transition from the discovery of etiologically defined entities to the development of systematic preventive programs. Unfortunately, in psychiatry, such entities have not yet been identified for the most part. Some mental disorders are related to etiologically defined diseases such as general paresis, pellagra, cretinism, post-traumatic psychoses. In each such instance the mental disorder is but one of many consequences of the disease, so that epidemiological research into the etiologically defined disease treats the mental disorder as but one of the many manifestations of the disease. In such an instance we are dealing with a simple cause which has multiple consequences. The studies on prenatal brain injury referred to earlier are similar in this respect, except that it would appear that psychological manifestations are sometimes the main evidence of the diseased state. One recent suggestion in psychiatry has the merit of advancing the proposal that there may be a disease defined etiologically in terms of the total absence of a primary emotional relationship in early childhood. Although the evidence for the existence of such an etiologically defined psychiatric entity is insufficient, it is a possibility capable of further investigation. Whether or not such investigation confirms the existence of such an etiologically defined disease, the suggestion is laudable because it draws attention to the need to advance straightforward etiological hypotheses.

Then there are a group of "diagnoses" we make in psychiatry which are descriptive in nature. We group cases together because of a common set of signs and symptoms and historical development of the illness. These descriptive diagnoses can also be studied. The epidemiology of schizophrenia, manic-depressive phychoses, motor-hysteria, obsessive-compulsive neuroses,

etc., can be studied. Many of the studies which have been made have been preoccupied with genetic relations between cases. These descriptive entities stand midway between the etiologically defined diseases (where we are interested in all the manifestations of a single cause) and the symptoms which are worth studying in themselves.

Certain symptoms are of great importance in themselves, either because they are so disabling or are in themselves damaging. For example, the epileptic convulsion is extremely disabling and many convulsions can be damaging in the long run to mental functioning. This single symptom is known to have many causes. Yet it is worthwhile to know how commonly the symptom occurs and under what circumstances the symptom is common as this helps to gain mastery over the symptom. The same can be said for hypoglycemia due to diabetes, even though the range of diseases causing hypoglycemia is much smaller. Epidemiological study of certain psychiatric symptoms is likewise of importance. It is well known for example that there is a vast range of diagnoses, etiological as well as descriptive, associated with suicide. Yet suicide is a vitally important symptom and many studies attest to the fact that this symptom has epidemiological characteristics rather independent of the distribution of psychiatric diagnoses. The same may be said for juvenile delinquency, alcohol addiction, opium addiction, school failures, reading disabilities, low intelligence test performance, paranoid thinking, phobias, etc. These symptoms may be characterized as patterns of behavior, patterns of thinking, attitudes, or ideas. Sometimes these are studied under the name of traits, symptoms, or defense mechanisms. Examples of such studies may be seen in recent Scandinavian work by Ekblad and others. (17) Opler (18) has recently shown in New York that young schizophrenic men from Italian families have different symptoms than young schizophrenic men from Irish families and that these differences are similar to the differences in characteristic personality patterns of the nonschizophrenic young

men from these two national groups. Two obvious characteristics are worthy of some attention. First, many people exhibit these symptoms without exhibiting either an etiologically defined disease or a descriptive psychiatric entity—this means that their distribution in the population overlaps people who are not suffering from mental diseases. Secondly, behavior patterns, thinking patterns, ideas, and attitudes are socially developed and this is undoubtedly true of those associated with disease as well as those not associated with disease. For this reason, it is sensible when studying the epidemiology of symptoms to pay particular attention to the social and cultural environment and to the relation between cases. The occurrence of the symptom can probably be understood only if all the instances of symptom formation are studied, those in people who have diagnosable diseases as well as those who do not. It is worth reemphasizing that great good can be done by reducing the frequency of certain behavior patterns in a population even when one is powerless to control the distribution of etiologically defined diseases or descriptive diagnostic entities. Alcohol and opiate addiction are obvious examples, as are suicide and juvenile delinquency.

Symptomatic responses to inner or outer stress, whether or not they are connected with the existence of disease, are particularly suitable for epidemiological searches for connections between cases and for relationships with the social and cultural environment of cases.

Etiologically defined diseases are particularly suitable for prospective studies which start with a population known to have been exposed to the cause of the disease compared with a population known to have been spared such an exposure. Such studies can bring out the many manifestations of the disease. They can elucidate the natural history of the disease. Pasamanick's studies on the consequences of complications of pregnancy have been mentioned. Dr. Hilda Lewis (19) in England has studied the relationship between separations and later psychopathology. In Holland, studies are being made on

the consequences of separations from families during the floods several years ago. Etiologically defined diseases need to be studied in terms of the conditions under which populations become exposed to the cause, and there are needs for studies of the distribution of the causes. Only if there is reason to suppose that the causative agent may be transmitted from one person to another is it necessary to study the relationship between cases.

Descriptively defined entities do not call for any particular type of study, but are amenable to any type which is in conformity with reasonable suspicions about the nature of the disease. Outstanding studies have been made by Lin (20) in Formosa; Bremer (21), Ødegaard (22), Larson and Sjögren (23) and others in Scandinavia; Murphy (24) in Singapore; Mayer-Gross (25) in England, and by others in various countries. One of the commonest faults of studies which have been made of the descriptively defined disease entities is a failure to distinguish between social inheritance and gene inheritance: there has been a fascination with familial patterns of disease. (26) Another fault, to which studies of descriptive entities are particularly prone is a failure to eliminate built-in epidemiological hypotheses from the definition of the disease. Thus morbidity surveys have been made on the assumption that schizophrenia is a life-long, usually progressive disorder, but find that the prevalence of cases falls off with age.

Our colleagues who are concerned with the prevention of physical diseases are way ahead of us because they know so much more about the etiology and the epidemiology of some of the major physical diseases. Only by recognizing that we need knowledge of these characteristics of disease can we mobilize the energy and work necessary to correct this situation. Generally speaking, research is of world-wide value. This is always true of laboratory research and clinical research and is commonly so with epidemiological research. However, each community must study the pattern of occurrence of mental disorders in its own population since the mental health problems

of each community are special. Only if we know what the special problems are in our own community can we plan our programs intelligently and effectively. There are many hopeful signs that the next few decades will produce vast amounts of new knowledge regarding the epidemiology of mental diseases, and as this knowledge increases we will be able to plan and execute definite programs for the prevention of mental diseases.

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THE INFLUENCE OF WAR AND POST-WAR CONDITIONS ON THE TEETH OF NORWEGIAN SCHOOL CHILDREN[1]

II. CARIES IN THE PERMANENT TEETH OF CHILDREN AGED 7–8 AND 12–13 YEARS

GUTTORM TOVERUD[2]

INTRODUCTION

CHANGES in the amount of caries in the permanent teeth of Norwegian school children during the school years 1940–1941 to 1948–1949 and 1951–1952 and 1952–1953 are described in this second report on the findings from an extensive, nationwide investigation conducted by the Pedodontic Department of the Norwegian State Dental School with the cooperation of the dentists in twenty-two school dental clinics in widely separated sections of Norway. This investigation was planned at the outbreak of World War II as a result of reports from several European countries, including Norway, that a marked reduction in dental caries among school

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The statistical treatment of the primary data has been carried out at the Milbank Memorial Fund, New York. I am very much indebted to the President, Dr. F. G. Boudreau, for the great interest he took in these studies in 1948 leading to a fellowship for my stay at the Milbank Fund in 1949–1950 and in 1955–1956 and for making the staff and all facilities available for analysis of these data and for the opportunity to publish the report in the *Quarterly*.

I want to express my sincere thanks to Miss Dorothy G. Wiehl, who has been responsible for the statistical treatment, for her interest and constant help. I am also indebted to her for reading the manuscript. I am very greatful to Mr. Louis Rubal for his painstaking work and many interesting and valuable suggestions. Thanks are also due to the other members of the staff for help in various ways.

Reprints of these reports are available through the Milbank Memorial Fund.

children occurred during World War I. It was hoped that, if a similar reduction in caries occurred under wartime conditions, the data collected would provide more evidence on the causes of the reduction.

In the first report, (Toverud, 1956) the population examined, the method of examination and the methods of tabulating the data are described in detail. A few items of primary interest are repeated here.

The children examined were from schools in cities, villages and rural districts in different parts of Norway, but it was not possible to obtain a random sampling of communities, partly because of the voluntary cooperation of dentists and partly because of conditions under the German Occupation. Furthermore, examinations were not done in every community in every school year; the same school grades were not included in every community; and, in a few communities, the grades examined varied from year to year. In order to minimize any effect on the findings of year-to-year variation in the composition of the population examined, data are presented for specific sex and age groups for selected groups of communities. Three basic community groups are used, namely, cities, villages and rural schools;[3] but data for several communities are shown separately either because the dental status differed in some respect from that of the appropriate basic group or for some special reason.

Children in grades 1 and 2 and 6 and 7 were examined in nearly all communities in each year for which any examinations were available. Consequently, the population is most constant and most representative at ages 7 and 8 years and at ages 12 and 13 years. For children of these ages, caries rates during the period of study are examined in this report.

General consistency of the trends in dental status for the different groups of communities affords the best evidence, it is be-

[3] The basic group of cities includes: Egersund, Fredrikstad, Larvik (ages 12 and 13 years only), Skudesneshavn, Tønsberg, and Tromsö. The village group includes: Aker, Baerum, Eidsvoll, Hedrum, Odda, Oppegaard, Ski, Stord, Strinda, and Tune. Rural districts combined are: Blaker, Fet, V. Gausdal and Meldal.

lieved, of their significance and validity. Statistical tests of significance are used sparingly since the sources of variation and error in the data are not limited to those associated with random sampling.

The previous report discussed the findings on changes during the study periods, 1940–1941 to 1948–1949 and 1951–1952 and 1952–1953, in eruption of the permanent teeth and also in retention and caries status of the deciduous predecessors, if any. In the following pages, and in a subsequent report, the changes observed in the amount of dental caries in the permanent dentition of the children examined will be described in detail. For specific sex-age groups in the different communities, annual rates for several measures of caries status will be presented. These measures include the following types of rates:

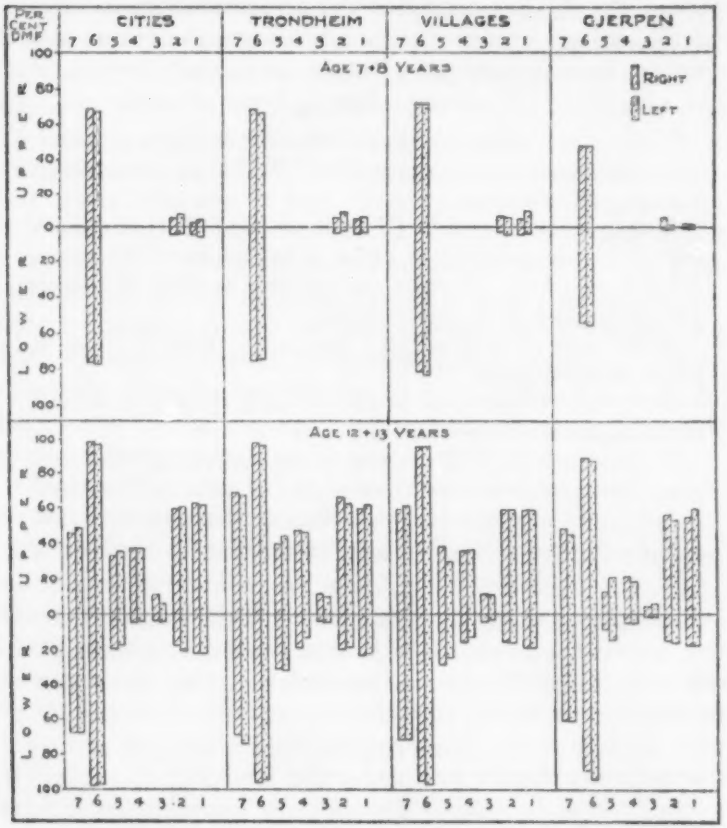
1. Per cent of children examined who had one or more permanent teeth decayed, missing, or filled (DMF), or, alternatively, the per cent caries free.
2. Average number of DMF teeth per child. This measure of individual susceptibility to caries is not as useful for young children who have a limited and variable number of erupted permanent teeth as for older children.
3. Per cent of total erupted permanent teeth found to be DMF on examination.
4. Per cent of the total number of each *specific* permanent tooth erupted that was DMF.
5. Percentage of DMF surfaces among the total surfaces for a *specific* erupted permanent tooth; usually extracted teeth are included with a constant number of carious surfaces estimated.
6. Percentage of DMF surfaces among the total surfaces of *all* erupted permanent teeth.

In the previous report, which described the dental examination, it was stated that after the first two years, namely 1940–1941 and 1941–1942, the dentists examined only the status of the dentition in the right half of the mouth. This was in accordance with earlier investigations which had indicated that it is really unnecessary to examine the whole dentition in order to obtain reliable prevalence rates for caries in population

groups. However, if the dentition on the right side was completely free of caries, the left side was examined in order to be sure that the child was really caries-free clinically.

A study of bilateral symmetry in the occurrence of caries in the permanent teeth was made for the year 1941–1942 to see whether the examination of only one-half of the dentition was justified in these studies of Norwegian school children.

Fig. 19. Percentages of specific teeth DMF on the right side of the mouth compared with percentages for corresponding teeth on the left side for boys examined in 1941–1942 in various communities. Specific teeth are numbered from 1 (central incisor) progressively to 7 (permanent second molar).



Bilateral Symmetry in the Occurrence of Caries in the Permanent Teeth

For the study of the reliability of the prevalence of caries in one-half of the dentition as an index of caries in the total dentition, the occurrence of caries in the specific permanent teeth on the right side has been compared with that on the left side.

Fig. 20. Percentages of specific teeth DMF on the right side of the mouth compared with percentages for corresponding teeth on the left side for girls examined in 1941–1942 in various communities. Specific teeth are numbered from 1 (central incisor) progressively to 7 (permanent second molar).

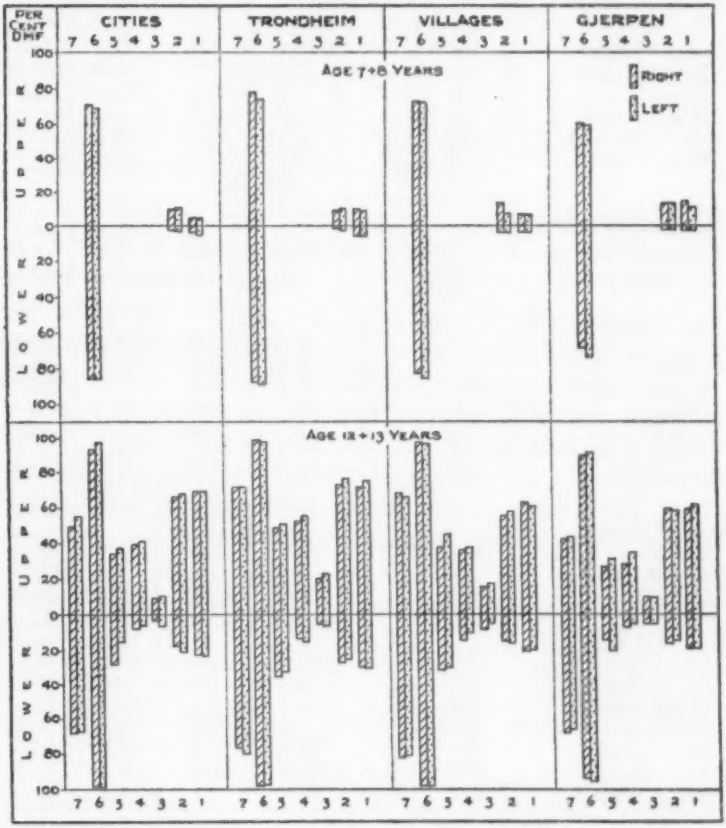


Table 16. Comparison of DMF rates for specific permanent teeth on the right side and on the left side in the lower jaw of 7+8 year old children and 12+13 year old children examined in 1941–1942.

Age at Examination and Specific Tooth in Lower Jaw	Boys			Girls		
	Number Having Tooth[1]	Per Cent of Teeth DMF		Number Having Tooth[1]	Per Cent of Teeth DMF	
		Right	Left		Right	Left
CITIES						
Age 7+8 Years						
First Molar	296	77.4	77.7	338	86.1	86.1
Central Incisor	294	4.4	4.8	340	3.5	4.7
Lateral Incisor	217	4.1	3.7	263	2.3	2.7
Age 12+13 Years						
First Molar	168	98.8	98.2	175	98.9	98.9
Central Incisor	168	22.0	22.0	176	23.3	23.9
Lateral Incisor	168	17.3	20.8	176	18.7	21.6
Cuspid	156	3.2	3.8	174	2.9	6.3
First Bicuspid	142	4.2	3.5	163	7.4	5.5
Second Bicuspid	122	19.7	17.2	143	28.0	14.7[b]
Second Molar	116	68.1	68.1	144	68.1	66.7
TRONDHEIM						
Age 7+8 Years						
First Molar	289	75.4	75.1	266	88.0	88.7
Central Incisor	263	4.2	3.4	254	5.5	5.9
Lateral Incisor	181	2.8	2.2	192	1.6	2.6
Age 12+13 Years						
First Molar	283	97.2	95.4	298	98.7	98.0
Central Incisor	283	23.0	22.3	297	30.3	30.6
Lateral Incisor	283	20.1	19.1	298	26.8	25.5
Cuspid	267	3.4	4.1	297	5.7	6.4
First Bicuspid	236	18.6	13.1	284	14.1	17.6
Second Bicuspid	197	30.5	31.5	240	35.4	32.9
Second Molar	200	70.0	75.0	244	77.5	80.3
VILLAGES						
Age 7+8 Years						
First Molar	351	80.6	82.9	388	83.0	85.8
Central Incisor	356	4.2	3.9	383	3.4	3.7
Lateral Incisor	253	2.4	4.0	303	4.0	4.0
Age 12+13 Years						
First Molar	266	97.0	98.9	240	97.9	98.3
Central Incisor	266	18.4	18.4	240	20.8	20.0
Lateral Incisor	266	15.0	15.4	239	15.1	17.6
Cuspid	255	3.5	3.1	239	8.4	4.6[b]
First Bicuspid	234	15.8	12.4	231	14.7	10.8
Second Bicuspid	207	28.0	23.7	202	32.2	30.7
Second Molar	196	72.4	72.4	193	82.4	81.9

Table 16 (Continued)

Age at Examination and Specific Tooth in Lower Jaw	Boys			Girls		
	Number Having Tooth[1]	Per Cent of Teeth DMF		Number Having Tooth[1]	Per Cent of Teeth DMF	
		Right	Left		Right	Left
	GJERPEN					
Age 7+8 Years						
First Molar	111	54.1	55.0	85	68.2	74.1
Central Incisor	113	0.9	0.9	87	2.3	2.3
Lateral Incisor	81	1.2	1.2	66	1.5	1.5
Age 12+13 Years						
First Molar	138	89.9	94.9[a]	151	94.7	96.0
Central Incisor	137	16.8	16.8	150	19.3	19.3
Lateral Incisor	138	14.5	15.9	151	17.2	14.6
Cuspid	130	0.8	0.8	147	4.8	4.8
First Bicuspid	125	4.8	4.8	142	7.0	5.6
Second Bicuspid	104	7.7	14.4	121	14.9	20.7
Second Molar	102	60.8	60.8	124	68.5	66.1

[1] Number of children with specified tooth erupted on both sides of lower jaw.
[a] Difference between percentages significant at 0.05 level.
[b] Difference between percentages significant at 0.01 level.

Rates for children aged 7 and 8 years and for those aged 12 and 13 years at last birthday are shown in Figures 19 and 20 for four community groups, namely, combined cities, Trondheim, combined villages, and Gjerpen. For the younger age group, rates have been used only for the incisors and first permanent molars. For each specific permanent tooth in the upper and in the lower jaw, the percentages DMF are shown in Figures 19 and 20; and in Table 16, the number of children examined, the DMF percentages for teeth in the lower jaw and the statistical significance of the difference between the DMF percentages for each tooth on the right and on the left side[4] are shown.

[4] Since the DMF percentages for a specified permanent tooth in the left and right sides of the dentition of the children examined in 1941–42, relate to teeth for the *same* children, the differences in rates for the antimeres were tested for significance by the χ^2 analysis appropriate for *correlated* percentages. Only children with both of the specified antimeres were considered so that each test becomes essentially a comparison of rates for two matched samples (*See*, Cochran, W. G.: *Biometrika*, December, 1950, 37, Parts 3 and 4.) Chi-square (with Yates' correction) was obtained from the following formula:

$$\chi^2_{(corr.)} = \frac{(|b - c| - 1)^2}{b + c}$$

(Continued on page 134)

As can be seen from Figures 19 and 20, the bilateral symmetry in the DMF status of the several teeth is very close in most cases. In a few instances some discrepancies are noticed, particularly in those morphological groups where only a very few erupted or carious teeth are present. The bilateral symmetry for the permanent first and second molars is very close, and these teeth, in most instances, also show the highest caries rates. Furthermore, the charts demonstrate very clearly that there is no systematic difference in the pattern of bilateral symmetry as between boys and girls or as between the different community groups.

The conclusion may be drawn from this preliminary analysis of bilateral caries that the examination of only the right half of the dentition should provide a closely accurate picture of the total dental condition. These bilateral symmetry studies confirm the results of earlier ones mentioned in Part I, Brekhus (1931), and also the more recent studies by Calonius (1953), Welander (1955), and others.

A further discussion of bilateral symmetry of caries and related questions will be taken up later in a separate publication.

Per Cent of Children with No Caries in Permanent Teeth

The dental health status of children is usually expressed in rates of occurrence of dental caries among individuals in a population group rather than of non-occurrence or freedom from caries. However, since we are interested in the "health" of the individual and of the population, it should be logical to record the frequency of *healthy* dentitions instead of *diseased* dentitions. The main reason for not doing so is that very few indi-

b = number of children with the left antimere DMF, but not the right; and
c = number of children with the right antimere DMF, but not the left.

A significant difference at the level selected (0.05) would have rejected the null hypothesis of no difference in the caries experience of the specified teeth in the right and left sides of the dentitions of the groups of children studied. As shown in Table 16, significant differences occurred in only three instances for teeth in the lower jaw. In the upper jaw, four differences were significant (P.01–.05), as follows: ages 7 + 8 years, lateral incisors for girls in villages; ages 12 + 13 years, first molars for girls in cities and second bicuspids for boys and for girls in villages.

Table 17. Per cent of boys and girls aged 7+8 years with no carious permanent teeth.

School Year	Number of Children Examined		Number of Children With No DMF Teeth		Per Cent With No[1] DMF Teeth	
	Boys	Girls	Boys	Girls	Boys	Girls
	CITIES					
1940–41	255	235	32	20	11.4	7.0
1941–42	306	346	51	35	17.9	8.6
1942–43	315	336	60	42	19.1	13.2
1943–44	327	315	88	58	26.9	17.5
1944–45	290	286	83	61	28.6	20.7
1945–46	355	274	116	64	30.3	25.6
1946–47	404	324	126	83	30.9	24.6
1947–48	411	397	105	78	24.9	18.5
1948–49	377	366	109	74	27.7	19.7
	TRONDHEIM[2]					
1940–41	220	195	40	17	14.6	7.5
1941–42	299	271	61	25	19.7	9.3
1942–43	266	257	66	27	25.8	10.5
1943–44	165	143	39	31	24.1	25.1
1944–45	117	145	34	38	27.2	26.9
1945–46	155	155	72	61	43.1	35.8
1946–47	209	223	39	23	20.4	11.1
	VILLAGES					
1940–41	371	358	59	39	15.0	9.6
1941–42	364	392	61	49	16.6	11.9
1942–43	428	404	126	69	28.6	16.4
1943–44	394	339	111	69	28.6	20.9
1944–45	263	284	83	80	32.2	27.7
1945–46	388	376	162	145	42.1	39.5
1946–47	256	252	109	76	42.2	30.5
1947–48	320	319	115	92	36.2	27.3
1948–49	311	314	99	56	31.5	18.9
	GJERPEN					
1940–41	103	95	33	25	34.5	27.2
1941–42	114	87	50	23	44.6	27.0
1942–43	117	89	65	34	57.4	40.8
1943–44	100	85	71	48	73.0	53.5
1944–45	104	100	77	69	73.8	67.5
1945–46	120	121	103	91	86.1	74.7
1946–47	141	137	115	97	80.9	71.3
1947–48	131	122	101	78	77.6	65.0
1948–49	121	120	95	81	79.0	67.8

[1] Adjusted to an equal number of children for each half-year of age and weighted for each half-year according to distribution of average number of erupted permanent teeth based on first three years.

[2] No examination in 1948–1949; and 7 year-old children only in 1947–1948.

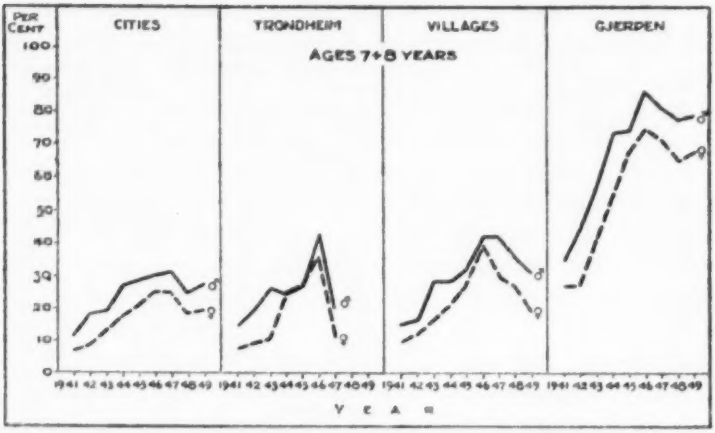


Fig. 21. Per cent of boys and of girls aged 7+8 years with caries-free permanent dentition in various communities during the period 1940–1941 to 1948–1949.

viduals in most countries of the Western world are free from dental caries. The child, starting with caries-free teeth, usually very early will acquire some caries, so that by the teen-age period not far from 100 per cent of children show evidence of past or present caries. Such high rates make impressive propaganda for prevention of this disease. Even if the percentage of diseased teeth among all permanent teeth is not nearly so high, certain groups of teeth, such as the molars, may have caries at almost the same high level. From a therapeutic point of view it is, of course, of great value to know the number or per cent of diseased teeth or diseased surfaces. In this publication, therefore, the usual DMF rates will be used to express dental health for the permanent dentition.

Before the rates for caries experienced by the children during the study period are examined, it is of interest to note the increase during the period in the percentages of children with caries-free permanent dentition. For boys and girls aged 7 and 8 years, the percentages with no caries in any erupted permanent tooth are shown in Table 17 and Figure 21. As will be seen, not more than from 7 to 15 per cent of the children in

combined cities, Trondheim, and villages had caries-free permanent teeth in 1940–1941. These rates increased considerably —about three to four times—up to 1945–1946, and then decreased. In Gjerpen the initial per cents as well as the later maximum per cents, also in 1945–1946, were much higher, 27–35 and 75–86 per cent, respectively for girls and for boys. In all four community groups, more boys than girls had caries-free dentition. In no instances are the figures for 1948–1949 as low as those for 1940–1941.

Average Number of DMF Permanent Teeth Per Child, 1940–1941 to 1948–1949

The average numbers of DMF permanent teeth per child in the years 1941–1949, in four community groups—cities, Trondheim, villages, and Gjerpen—are shown in Figure 22 and Table 18 for age groups 7 + 8 years and 12 + 13 years.[8]

7 + 8 Year-Old Children. As will be seen from Figure 22, the initial average number of carious teeth per person, for children 7 + 8 years old, is about the same for cities, Trondheim, and villages, ranging from 3.2 to 4.0 DMF teeth. The averages decrease steadily each year until 1946 and then rise again. The values for Gjerpen are lower, and the reduction greater, but the shape of the curves is similar. The reduction for Gjerpen amounts to 2.3–2.4 and for the other groups 1.1 to 1.9 teeth per child. The percentage reduction varies from 75 to 85 per cent in Gjerpen and from 32 to 50 in the three other communities.

12 + 13 Year-Old Children. For the age group 12 + 13 years, the curves for cities and villages are practically identical throughout. In 1941, the first year, the average for boys is 11 DMF teeth and for girls 12.4 to 12.8. Here, too, we find a drop

[8] Ages 7 and 8 years and ages 12 and 13 years have been combined in many of the charts and tables for the various DMF rates in order to reduce erratic annual variations by using larger numbers of children. In most instances, the DMF rates have not been adjusted for single years of age within the combined age groups. Rates adjusted for age by single years and by half-years were computed for many population groups but the results differed so little from the unadjusted rates that the latter have been used.

Table 18. Average number of permanent teeth DMF per child, by sex and age groups 7+8 and 12+13 years, for children in cities, Trondheim, villages and Gjerpen, 1940–1941 to 1948–1949.

Age and School Year	Boys				Girls			
	Cities	Trondheim	Villages	Gjerpen	Cities	Trondheim	Villages	Gjerpen
	AVERAGE NUMBER OF PERMANENT TEETH DMF PER CHILD[1]							
Age 7+8 Years								
1940–41	3.2	3.3	3.2	2.7	3.8	4.0	3.7	3.1
1941–42	3.1	3.0	3.2	2.1	3.4	3.6	3.4	2.9
1942–43	2.9	2.9	2.5	1.5	3.3	3.3	3.1	2.1
1943–44	2.5	2.6	2.4	0.9	2.7	2.8	2.9	1.2
1944–45	2.5	2.4	2.3	0.7	2.6	2.5	2.4	0.9
1945–46	2.2	1.7	1.9	0.4	2.4	2.1	2.1	0.8
1946–47	2.2	2.8	1.9	0.6	2.5	3.6	2.4	0.9
1947–48	2.5	—	2.2	0.7	2.8	—	2.3	1.2
1948–49	2.3	[a]	2.2	0.6	2.7	[a]	3.0	1.1
Age 12+13 Years								
1940–41	11.0	12.0	11.0	10.2	12.4	12.6	12.8	10.6
1941–42	10.7	11.8	11.1	9.0	11.6	13.7	12.0	10.3
1942–43	9.7	11.3	10.0	8.2	11.0	13.0	11.2	8.9
1943–44	9.0	9.7	9.2	7.2	10.5	12.3	10.4	6.7
1944–45	7.9	8.7	8.5	6.3	10.0	10.8	9.5	6.9
1945–46	7.9	8.6	7.7	4.5	9.4	10.1	8.9	5.7
1946–47	7.1	9.8	7.7	3.9	8.8	12.2	9.1	4.8
1947–48	7.3	11.1	7.7	3.7	9.2	[c]	8.6	4.6
1948–49	7.8	[a]	7.7	3.8	8.8	[a]	8.8	3.7
	NUMBER OF CHILDREN							
Age 7+8 Years								
1940–41	255	220	371	103	235	195	358	95
1941–42	306	299	364	114	346	271	392	87
1942–43	315	266	428	117	336	257	404	89
1943–44	327	165	394	100	315	143	339	85
1944–45	290	117	263	104	286	145	284	100
1945–46	355	155	388	120	274	155	376	121
1946–47	404	209	256	141	324	223	252	137
1947–48	411	[b]	320	131	397	[b]	319	122
1948–49	377	—	311	121	366	—	314	120
Age 12+13 Years								
1940–41	206	303	296	146	180	307	262	157
1941–42	168	283	266	138	176	298	240	151
1942–43	230	240	275	135	195	250	267	148
1943–44	304	146	333	135	330	167	300	132
1944–45	320	155	360	131	332	174	298	135
1945–46	270	211	400	130	292	235	379	112
1946–47	271	187	249	133	271	195	221	109
1947–48	276	110	296	132	311	[c]	280	94
1948–49	285	—	299	109	277	—	264	95

[1] Average number for whole mouth; average values for teeth on right side are multiplied by two.
[a] No examinations in 1948–1949.
[b] Seven-year olds only in 1947–1948.
[c] Thirteen-year old girls only in 1947–1948.

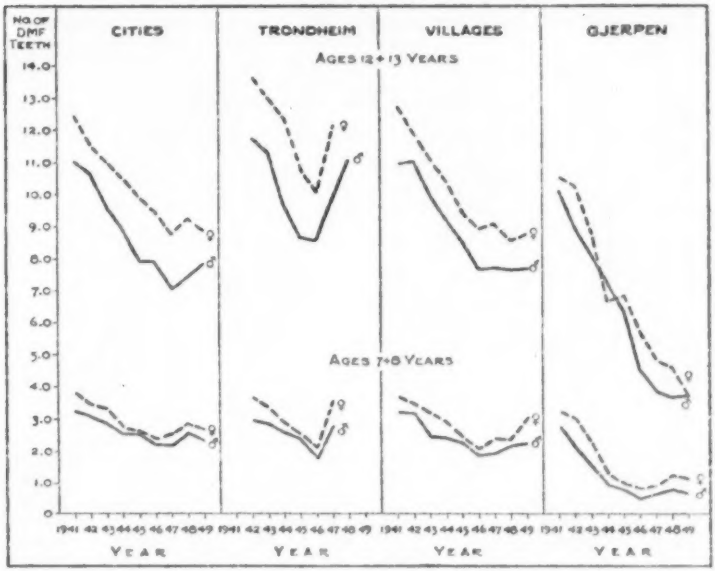


Fig. 22. Average number of permanent teeth DMF per child at ages 7 + 8 and 12 + 13 years in various communities, 1940–1941 to 1948–1949.

in the curves, the lowest level being reached in 1947 for cities, and 1946 to 1948 for villages. In Trondheim, values are somewhat higher, reached a low in 1946, and the upturn, after 1946, is sharper. Gjerpen shows definitely lower values in this age group, as at the younger ages, and the curves drop steadily until 1949. From 1940–1941 to the lowest value, the reduction in the average number of carious teeth per child in cities and in villages amounts to 3.3–4.2, with a percentage reduction of 30–36. In Gjerpen the corresponding figures are 6.5–6.9 teeth and 64–65 per cent.

Figure 23 shows the average number of DMF teeth per child for each of the ages 7, 8, 12, and 13 years separately in the same four community groups. Curves for single years of age are somewhat irregular but there is no essential difference in the trends from those shown in Fig. 22. The increase with age in the average number of DMF teeth is demonstrated in Fig.

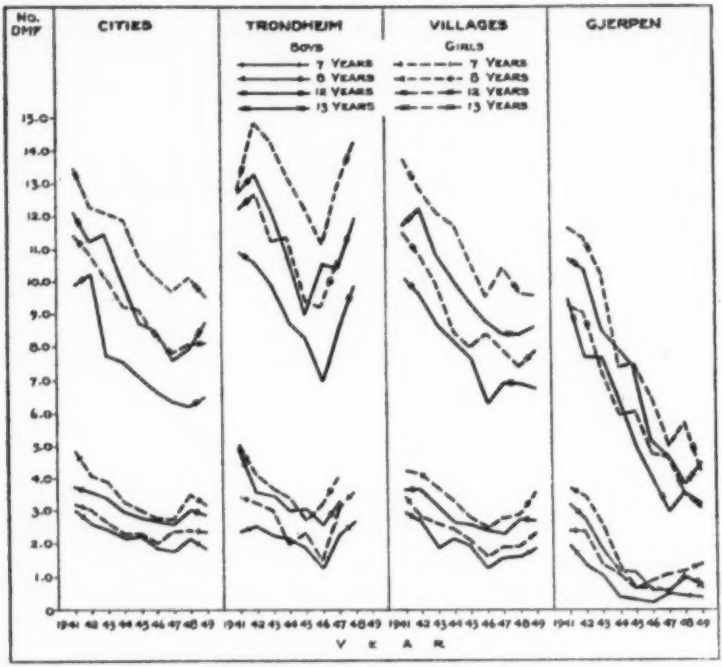


Fig. 23. Average number of permanent teeth DMF per child at ages 7, 8, 12 and 13 years in various communities, 1940–1941 to 1948–1949.

23. This reflects both an increase in the number of teeth erupted and in the number of teeth affected by caries.

DMF Teeth as Percentages of Total Erupted Permanent Teeth

The percentages of the erupted permanent teeth that were found to be decayed, missing, or filled for boys and girls examined each year from 1940–1941 to 1948–1949 describe changes in the development of caries during the period better than the average numbers of DMF teeth since the time of eruption of permanent teeth was not constant throughout these years. The percentages of the total erupted permanent teeth that were DMF are shown in Table 19 for boys and for girls at ages

Table 19. Per cent of total permanent teeth DMF for boys and girls at ages 7+8 years and 12+13 years in cities, Trondheim, villages, Gjerpen and rural districts, 1940–1941 to 1948–1949.

Age and School Year	Boys					Girls				
	Cities	Trondheim[1]	Villages	Gjerpen	Rural Districts	Cities	Trondheim[1]	Villages	Gjerpen	Rural Districts
	PER CENT OF TOTAL PERMANENT TEETH DMF									
Age 7+8 Years										
1940–41	34.5	36.5	33.4	27.7	36.4	34.9	40.7	34.8	28.5	36.3
1941–42	30.3	32.9	31.8	20.3	30.5	31.7	35.0	32.0	26.9	32.0
1942–43	29.1	31.0	25.1	15.3	29.4	30.0	33.8	29.0	19.9	29.2
1943–44	25.3	27.8	25.2	8.5	22.5	25.6	26.6	27.9	11.6	23.0
1944–45	25.1	25.3	24.1	7.8	17.8	25.6	24.7	24.0	8.7	18.3
1945–46	23.9	18.8	19.8	4.6	16.5	22.6	20.5	20.0	7.4	14.8
1946–47	23.9	29.7	20.6	6.4	19.5	24.8	35.2	23.4	8.5	19.6
1947–48	27.6	[a]	23.3	7.8	22.1	27.5	[a]	23.4	11.1	24.7
1948–49	24.6	—	23.8	6.4	23.7	25.3	—	28.3	10.0	24.3
Age 12+13 Years										
1940–41	42.2	45.5	42.5	39.6	43.2	46.4	46.4	48.2	40.2	49.4
1941–42	41.5	45.9	42.8	34.7	46.4	43.2	51.2	45.4	39.0	49.9
1942–43	38.5	43.9	38.6	32.4	39.4	41.7	49.0	42.2	33.5	43.3
1943–44	35.4	38.0	36.8	28.8	36.7	39.9	46.7	39.5	24.9	37.3
1944–45	31.8	33.6	34.0	25.2	31.8	38.1	41.0	36.4	26.0	34.2
1945–46	31.3	33.7	30.7	18.7	28.6	35.7	38.7	34.2	21.7	29.1
1946–47	28.6	38.5	30.9	15.8	26.6	33.7	46.6	35.1	18.4	28.1
1947–48	28.9	44.5	31.1	14.6	30.7	35.2	[b]	33.1	18.3	29.5
1948–49	31.1	—	31.9	15.3	25.9	33.9	—	34.4	14.6	28.2
	NUMBER OF ERUPTED PERMANENT TEETH									
Age 7+8 Years										
1940–41	1,200	1,007	1,791	506	338	1,283	958	1,900	519	422
1941–42	1,552	1,362	1,823	582	223	1,864	1,411	2,103	476	278
1942–43	1,548	1,233	2,093	570	228	1,848	1,262	2,182	478	319
1943–44	1,623	766	1,887	505	355	1,659	762	1,760	439	549
1944–45	1,440	549	1,233	489	432	1,457	736	1,417	520	568
1945–46	1,617	714	1,816	566	577	1,446	785	1,937	632	561
1946–47	1,842	987	1,198	652	478	1,639	1,128	1,278	718	450
1947–48	1,899	—	1,481	625	389	2,051	—	1,588	659	389
1948–49	1,766	—	1,454	596	414	1,940	—	1,671	643	452
Age 12+13 Years										
1940–41	2,697	3,991	3,828	1,871	969	2,411	4,156	3,465	2,063	731
1941–42	2,158	3,627	3,442	1,782	757	2,356	3,986	3,165	1,987	751
1942–43	2,889	3,086	3,549	1,699	574	2,573	3,314	3,537	1,959	1,054
1943–44	3,860	1,868	4,180	1,690	1,013	4,363	2,204	3,962	1,763	1,255
1944–45	3,993	1,995	4,530	1,640	1,107	4,341	2,289	3,882	1,781	1,242
1945–46	3,413	2,676	5,017	1,581	1,129	3,851	3,058	4,948	1,464	1,274
1946–47	3,342	2,388	3,107	1,641	890	3,527	2,554	2,870	1,427	1,047
1947–48	3,502	1,375	3,655	1,653	798	4,088	[b]	3,627	1,182	920
1948–49	3,597	—	3,624	1,343	868	3,613	—	3,377	1,200	1,088

[1] No examinations in 1948–1949.
[a] Seven year-olds only examined in 1947–1948.
[b] Thirteen year-old girls only examined in 1947–1948.

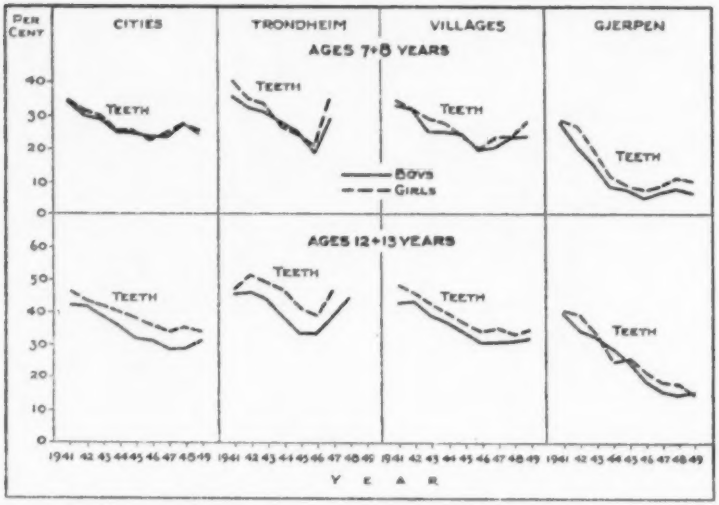


Fig. 24. Per cent of total permanent teeth DMF at ages 7 + 8 years and 12 + 13 years in various communities, 1940–1941 to 1948–1949.

7 and 8 years combined and at ages 12 and 13 years combined for each of the community groups. Trends in the DMF rates are depicted in Fig. 24.

Ages 7 + 8 Years. At ages 7 and 8 years, the percentages for DMF teeth are highest in the first year 1940–1941 and decrease to the lowest percentage in 1945–1946 in the combined cities, Trondheim, combined villages, Gjerpen, and in the combined rural districts.[6] After 1946, there is an increase in the DMF

[6] Variation among annual DMF rates for specific sex-age groups in each of the groups of communities and in the communities shown separately is significant at the .01 level or less by the χ^2 test of significance for variation among a series of percentages, and the differences between minimum and maximum DMF rates are highly significant. This estimate of the probability that the observed variation could occur from chance alone depends on an assumption that data for each year are for independent, randomly selected individuals in the given populations, a condition which does not fully apply to these data for several reasons: (1) the number of teeth on which the DMF per cent is based is not a completely independent number of observations since one tooth is not "independent" of all other teeth in the same mouth in the usual statistical sense; (2) the populations examined are not distributed equally each year among the various schools and communities in the combined community groups and in a single community are not distributed equally each year among different schools; so that there is a possibility of some selective variation as a result of differences in the populations examined or differences in

(Continued on page 143)

rates. These changes are consistent for both boys and girls.

Although the trends in DMF rates are similar for the different community groups, the amount of the reduction from 1941 to 1946 varies. In the cities, for boys the DMF rate decreased from 34.5 to 23.9 per cent, a reduction of 31 per cent; in villages, the rates were 33.4 and 19.8 per cent, a reduction of 41 per cent. In Trondheim, the DMF rate for boys decreased 49 per cent, and in Gjerpen the DMF rate for boys was only 4.6 in 1945–1946 giving a percentage reduction of 83. For the combined rural districts, the DMF percentages for boys decreased from 36.4 in 1941 to 16.5 in 1946, a decrease of 54 per cent.

As may be seen in Fig. 24, DMF rates for girls show approximately the same reduction as the DMF rates for boys in each of the community groups.

Ages 12 + 13 Years. At ages 12 and 13 years, the percentages of the total permanent teeth that were DMF showed a downward trend in all the community groups, but there was very little or no decrease in rates until 1942–1943 and the minimum rates did not occur in the same year in the different communities. However, most of the reduction in DMF rates occurred from 1941–1942 to 1945–1946, and, in the following three years, changes in DMF rates were very small in the various community groups, with the exception of Trondheim.

The DMF rates at ages 12 + 13 years were almost the same in cities as in villages throughout the period 1941 to 1949 both among boys and among girls. Among boys, the DMF rate for

diagnostic standards of the examining dentists; and (3) rates for successive years for children aged 7 + 8 years, or 12 + 13 years, are not based on independent populations since most of the children 7 or 12 years of age in one school year are included at ages 8 or 13 in the next year. When the third factor of correlation between successive ages in successive years is eliminated by computing annual rates for single years of age, the variation among annual rates for the different communities is significant at the .01 level or less; but the effect of the other two factors cannot so easily be eliminated. Since the usual statistical measures of variation in rates that might be expected as a result of simple random sampling are not appropriate to these data the results of such tests are not given. Patterns of change are of principal interest, as previously stated, and the validity of specific trends in dental caries in these communities is based chiefly on consistency of these patterns. Some fairly large irregularities in rates from year to year for a community group may result from a combination of several types of sampling and error variation; and, on the other hand, small changes from year to year may have real significance if part of a consistent pattern.

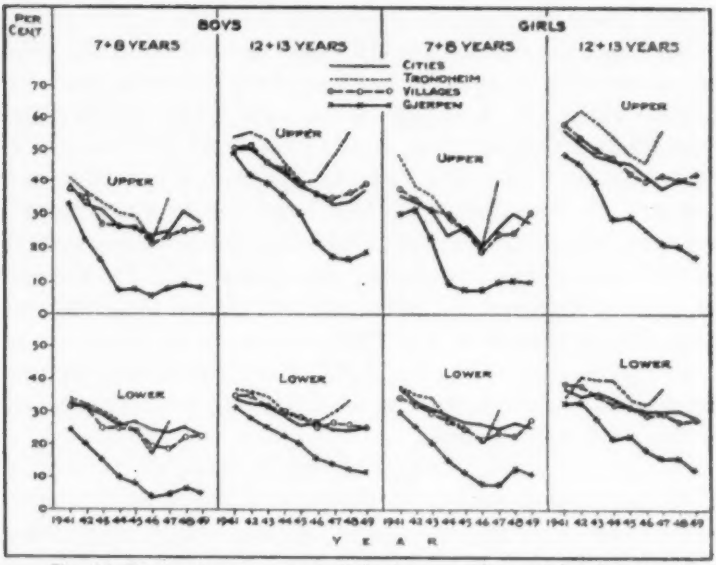


Fig. 25. For total permanent teeth in the upper jaw and for those in the lower jaw, the per cent DMF at ages 7+8 years and at ages 12+13 years in various communities, 1940–1941 to 1948–1949.

permanent teeth was 42 per cent in 1940–1941 in cities and in villages. The percentage in cities decreased to 28.6 in 1946–47 and in villages to 30.7 in 1945–1946, reductions of 32 and 28 per cent, respectively. Among girls, the reduction in the DMF rates was 27 per cent in cities and 31 per cent in villages from initial rates of 46 and 48 per cent DMF teeth.

In Trondheim, the maximum DMF rates were recorded in 1941–1942, 45.9 and 51.2 for boys and girls, respectively. The decrease in rates amounted to 27 per cent for boys and 24 per cent for girls in 1945–1946, and in this City there was a definite rise in the DMF rates in the school year 1946–1947.[7]

The greatest reduction in the percentage of DMF teeth is found for Gjerpen. From rates of 40 per cent in 1940–1941 for both boys and girls, the rates decreased to 15 per cent, a reduc-

[7] Examinations were done in a reduced number of schools in Trondheim in 1947–1948. For the children examined, the DMF rates showed a further increase over the preceding year. No children were examined in 1948–1949.

Table 20. Per cent of total permanent teeth DMF in the upper and lower jaws separately for 7+8 and 12+13-year old children in cities, Trondheim, villages and Gjerpen, 1940–1941 to 1948–1949.

Age and School Year	Upper Jaw				Lower Jaw			
	Cities	Trondheim[2]	Villages	Gjerpen	Cities	Trondheim[2]	Villages	Gjerpen
	BOYS—PER CENT OF TEETH DMF							
Ages 7+8 Years[1]								
1940–41	38.7	40.9	37.4	33.0	33.2	33.8	31.6	24.5
1941–42	32.7	36.6	34.5	22.0	30.6	31.3	31.3	19.9
1942–43	31.2	33.0	26.9	16.2	29.0	29.9	24.8	15.0
1943–44	26.4	30.2	26.5	7.5	25.7	26.7	25.0	9.7
1944–45	25.9	29.6	26.2	8.1	26.6	23.6	23.7	8.1
1945–46	23.8	22.0	21.4	5.8	24.4	16.4	19.1	3.8
1946–47	25.0	34.8	23.5	8.2	23.7	26.8	18.4	4.9
1947–48	30.9	—	25.0	9.1	25.3	—	22.0	6.9
1948–49	27.9	—	25.9	8.0	22.8	—	22.3	5.2
Ages 12+13 Years								
1940–41	50.5	54.3	50.4	48.3	34.2	36.7	34.8	31.1
1941–42	50.3	55.6	50.9	41.7	32.6	36.2	34.8	27.7
1942–43	45.8	53.0	45.8	39.8	31.4	34.7	31.7	25.1
1943–44	42.5	46.1	43.6	35.4	28.4	29.8	30.1	22.4
1944–45	38.3	39.2	39.7	30.5	25.4	28.2	28.3	20.1
1945–46	36.4	40.3	36.0	21.9	26.4	27.3	25.5	15.6
1946–47	32.8	47.4	35.0	17.6	24.6	29.8	26.9	14.0
1947–48	33.7	55.5	36.5	16.7	24.2	33.9	25.8	12.5
1948–49	37.5	—	39.1	19.2	24.9	—	25.0	11.5
	GIRLS—PER CENT OF TEETH DMF							
Ages 7+8 Years[1]								
1940–41	35.9	48.4	37.7	30.2	37.0	37.5	34.4	29.9
1941–42	33.7	38.5	34.3	31.9	32.5	35.0	31.9	25.2
1942–43	31.5	35.8	30.7	22.7	30.7	34.3	29.6	20.0
1943–44	24.1	28.7	30.0	9.5	28.8	27.1	27.2	14.2
1944–45	26.2	25.2	24.9	7.7	26.7	25.4	24.4	10.5
1945–46	20.6	20.8	19.2	7.4	26.2	20.9	21.3	7.9
1946–47	25.7	40.4	24.3	10.1	25.1	31.2	23.2	7.6
1947–48	30.3	—	24.4	10.3	26.5	—	22.5	12.6
1948–49	27.5	—	30.6	10.0	24.9	—	27.4	10.5
Ages 12+13 Years								
1940–41	56.1	58.0	57.8	48.4	36.8	34.7	38.8	32.3
1941–42	52.0	62.0	53.4	45.6	34.4	40.3	37.6	32.5
1942–43	48.1	58.6	49.8	39.8	35.4	39.5	34.7	27.4
1943–44	46.2	54.0	47.1	28.6	33.6	39.5	32.1	21.3
1944–45	45.5	48.5	42.1	29.7	30.8	33.6	30.8	22.4
1945–46	41.4	45.5	39.8	25.8	30.1	31.9	28.6	17.7
1946–47	38.1	56.2	41.4	21.4	29.5	37.2	28.9	15.6
1947–48	40.4	—	40.0	21.0	30.1	—	26.3	15.7
1948–49	39.8	—	42.1	17.5	28.2	—	27.0	11.8

[1] Only incisors and first molars included at ages 7+8 years.
[2] No examinations in 1948–1949; in 1947–1948, 8 year-old children and 12 year-old girls not examined.

tion of 63 per cent. The minimum rates occurred in 1947 to 1949.

For the combined rural districts, the percentage reduction from 1940–1941 rates was 40 for boys and 43 for girls, and minimum rates were recorded in 1946–1947.

DMF Rates for Upper and Lower Jaws. The percentages of the total erupted permanent teeth in the upper and lower jaw separately that were decayed, missing or filled are shown for boys and girls aged 7 + 8 years and 12 + 13 years in each community group in Fig. 25 and Table 20. For both jaws, the DMF rates decreased considerably in the period 1940–1941 to 1948–1949. At ages 7 + 8 years, the lowest DMF rates for the upper teeth are in 1945–1946 for both boys and girls in combined cities, Trondheim, combined villages and in Gjerpen, and there is a tendency for the rates to increase in 1946–1947. For teeth in the lower jaw, the minimum DMF rates are in 1945–1946 or 1946–1947 and there are very small differences between these two years for each sex in all community groups except Trondheim where rates were higher in 1946–1947. At ages 12 + 13 years, the lowest rates were recorded from 1945–1946 to 1948–1949. For teeth in the upper jaw, there is a slight increase in DMF rates in 1947–1948 or 1948–1949 except among girls in Gjerpen. Rates for the lower jaw continued downward or leveled off after 1945–1946 except in Trondheim.

Differences between the caries rates for the upper and lower jaw are small for girls and somewhat larger for boys aged 7 + 8 years of age. At these ages only the incisors and first molars have been considered. The lower first molar has a higher caries rate than the upper but the lower incisors have lower caries rates than the upper. These differences are nearly counterbalanced at ages 7 + 8 years. Differences in caries rates for individual teeth are discussed in the next section.

In the 12 + 13 year-old groups, rather large differences in the DMF rates for the two jaws are apparent. In the cities, Trondheim, and in villages, rates for the lower jaw in 1940–1941 range from 34 to 37 per cent for boys and 35 to 39 per cent for

girls compared with rates for the upper jaw of 50 to 54 per cent for boys, 56 to 58 per cent for girls. The values for Gjerpen are lower but the same relationship is present. The maximum reduction in Gjerpen was about 64 per cent both in the upper and in the lower jaw. In cities and villages, the maximum reduction in DMF rates for the upper jaw was 28 to 35 per cent and for the lower jaw was slightly less for corresponding community and sex groups.

The magnitude of the difference between the upper and lower jaw at ages 12 + 13 years is explained by an increase in the excess of caries in upper incisors as compared to caries in lower incisors as age advances whereas the difference between upper and lower first molars is eliminated since nearly all first molars are carious by age 12 + 13 years.

DMF Rates for Specific Teeth in the Upper and Lower Jaws

For specific permanent teeth erupted, the percentages DMF are shown in Table 21a and b for boys and girls aged 7 + 8 in each of the community groups. Corresponding percentages are given in Tables 22a and b for ages 12 + 13. Figure 26 illustrates changes in the DMF status of each tooth during the period 1941 to 1949 for boys and girls aged 7 + 8 years and 12 + 13 years in the villages, and is representative of findings in the cities. This chart demonstrates clearly the relative caries rates for the specific permanent teeth in these age groups. The order of susceptibility of the various teeth is the same as that usually found. For every morphological type of tooth, in boys and in girls, each curve declines from the levels of 1941 or 1942. At ages 7 + 8 years, the lowest values are found in 1945 or 1946; after these years the rates rise except those for the lower incisors. At ages 12 + 13 years, the school years with the lowest values are not identical for the different teeth and vary from 1946 to 1949. The teeth with the shortest post-eruptive age—the second molars and the upper cuspids—usually follow the pattern of the 7 + 8 year old group, whereas the teeth with the

Table 21a. Per cent DMF for specific teeth at ages 7+8 years in cities, Trondheim, villages, Gjerpen and rural districts, 1940–1941 to 1948–1949, and 1951–1952 and 1952–1953 in Gjerpen.

Age and School Year	Boys—7+8 Years						Girls—7+8 Years					
	Central Incisor		Lateral Incisor		First Molar		Central Incisor		Lateral Incisor		First Molar	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
	CITIES											
1940–41	5.0	2.9	6.5	2.4	75.0	84.1	7.7	9.9	9.9	5.2	75.6	90.5
1941–42	3.0	4.4	5.0	3.9	67.6	77.6	5.4	3.5	9.4	2.2	70.1	85.7
1942–43	4.0	2.3	9.4	1.8	61.5	74.3	4.9	2.1	7.1	1.1	67.9	82.9
1943–44	2.4	0.9	3.3	1.3	54.3	68.2	2.3	1.0	0	0.4	55.3	78.7
1944–45	0.4	0.4	1.9	0.5	56.4	70.8	1.8	0.7	4.0	0	57.0	73.3
1945–46	0.4	0.3	1.1	0.5	47.7	63.3	1.3	0.4	1.6	0.5	47.0	71.6
1946–47	2.0	1.3	3.7	0.4	49.1	61.0	1.6	0.6	6.8	0	54.7	67.9
1947–48	3.5	0.7	8.1	0.8	59.9	66.8	4.7	1.3	9.4	0.3	62.5	71.6
1948–49	0.7	0.5	3.2	0.8	58.0	60.7	3.8	0.6	4.1	0.7	61.4	68.5
	TRONDHEIM[1]											
1940–41	8.3	5.4	17.9	4.7	71.2	78.4	15.7	9.0	23.5	5.3	81.8	87.1
1941–42	4.9	4.1	5.0	2.7	67.7	74.0	9.3	5.4	8.0	1.5	76.6	88.1
1942–43	5.6	5.2	9.5	6.0	62.0	68.8	6.4	3.7	5.8	1.2	70.6	86.3
1943–44	2.4	1.3	0	1.0	62.4	69.0	2.4	2.8	7.2	0.9	63.7	73.2
1944–45	3.7	1.8	2.7	1.4	57.7	59.1	0.9	0.7	1.4	0	56.6	69.5
1945–46	0.9	0	7.7	0	41.3	42.9	3.8	0.7	6.7	0	41.8	57.7
1946–47	2.6	1.9	9.4	0.7	68.0	70.1	10.4	3.2	14.3	3.7	79.5	79.2
	VILLAGES											
1940–41	5.7	3.3	6.4	2.6	73.3	81.9	7.2	6.8	10.6	4.7	77.8	86.9
1941–42	5.3	4.2	5.7	2.3	71.9	79.9	6.5	3.4	11.6	3.8	72.8	83.1
1942–43	2.7	2.2	5.5	1.3	55.6	64.0	6.0	2.5	4.6	1.6	67.3	79.1
1943–44	2.6	1.3	4.8	1.5	54.4	64.5	6.9	0.9	8.3	0.7	62.0	74.8
1944–45	1.1	1.2	2.4	0.6	53.2	61.7	2.7	0	3.1	0	54.1	66.5
1945–46	2.4	1.4	4.6	1.3	41.6	47.2	2.5	0.8	4.3	1.1	41.3	56.9
1946–47	4.0	0.8	8.8	0.6	44.1	48.2	4.2	0.4	7.7	0	49.6	64.3
1947–48	4.2	0.6	6.2	0	48.7	58.9	4.6	0.6	6.7	0	50.3	62.7
1948–49	3.8	0.3	3.8	0	51.9	59.4	4.2	1.0	6.8	0.8	67.6	75.8
	GJERPEN											
1940–41	8.5	5.9	13.2	2.7	61.2	60.0	12.2	8.7	14.8	5.1	56.2	72.0
1941–42	1.1	0.9	4.4	1.1	48.1	54.1	13.3	2.3	12.5	1.4	59.5	68.2
1942–43	3.6	0.9	2.4	0	30.2	39.3	5.4	0	9.1	0	44.7	55.7
1943–44	1.2	1.0	0	1.4	16.5	24.2	0	2.4	0	0	22.8	36.9
1944–45	2.6	0	0	0	14.9	20.6	1.2	1.0	0	0	16.8	27.6
1945–46	0	0	0	0	11.8	10.0	0	0	0	0	17.9	21.8
1946–47	3.9	0	10.0	0	10.9	12.9	1.8	0.7	4.4	0.9	20.1	19.9
1947–48	1.9	0	2.2	1.1	17.5	18.4	2.9	1.7	2.8	1.0	21.6	32.8
1948–49	2.1	0	2.0	0	15.4	14.4	2.0	0.9	4.8	0	19.8	28.3
1951–52	1.7	0	2.1	0	29.2	25.9	8.0	0	10.8	0	32.5	38.9
1952–53	2.6	0	6.8	0.7	31.4	33.7	6.0	1.6	8.3	1.3	41.7	49.2
	RURAL DISTRICTS											
1940–41	11.1	9.1	23.1	4.1	77.8	79.7	10.6	8.8	11.1	6.4	74.7	88.8
1941–42	5.4	0	11.1	0	69.0	83.3	0	2.0	7.4	0	80.4	88.0
1942–43	2.6	2.2	0	0	71.7	71.1	1.8	0	7.4	0	66.7	81.7
1943–44	0	0	4.2	0	54.2	54.2	1.1	0	2.0	0	60.6	58.1
1944–45	0	0	0	0	38.1	52.3	1.1	0	2.0	0	44.0	49.1
1945–46	0	0	1.9	0	35.8	48.6	0	0	0	0	30.9	45.4
1946–47	0	0	4.9	0	43.8	56.2	1.4	0	4.8	0	38.8	61.2
1947–48	3.3	0	6.7	0	53.2	53.9	0	0	0	0	55.8	67.5
1948–49	0	0	0	0	60.3	63.3	0	0	0	0	59.1	65.2

[1] No examinations in Trondheim in 1948–1949; and 8 year-olds not examined in 1947–1948.

Table 21b. Number of specific permanent teeth erupted at ages 7+8 years in cities, Trondheim, villages, Gjerpen and rural districts, 1940–1941 to 1948–1949, and 1951–1952 and 1952–1953 in Gjerpen.

Age and School Year	Boys—7+8 Years						Girls—7+8 Years					
	Central Incisor		Lateral Incisor		First Molar		Central Incisor		Lateral Incisor		First Molar	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
	CITIES											
1940–41	180	241	77	170	236	246	209	232	111	192	221	232
1941–42	233	298	119	233	293	299	297	341	160	275	338	343
1942–43	251	306	106	217	301	311	288	328	182	272	333	334
1943–44	253	317	120	237	317	321	266	312	151	238	304	310
1944–45	227	281	107	199	273	284	227	285	125	213	270	281
1945–46	253	338	90	216	333	343	238	270	123	207	264	271
1946–47	295	391	109	247	377	390	255	317	147	240	309	321
1947–48	310	401	123	258	389	391	321	392	191	298	379	391
1948–49	281	367	124	250	355	361	317	359	193	292	355	362
	TRONDHEIM[1]											
1940–41	144	203	67	129	205	213	140	189	68	131	187	194
1941–42	203	267	80	187	288	296	215	257	125	197	265	268
1942–43	197	248	84	168	255	260	188	245	103	173	248	255
1943–44	123	159	54	103	157	158	123	141	69	112	135	138
1944–45	82	112	37	74	111	115	117	142	69	106	143	141
1945–46	111	152	39	96	150	154	131	152	60	116	146	149
1946–47	153	206	64	138	197	201	183	221	105	161	210	221
	VILLAGES											
1940–41	283	361	110	272	345	359	307	352	161	296	343	352
1941–42	302	357	141	261	345	354	340	385	215	318	372	390
1942–43	335	417	164	299	405	419	351	397	217	320	391	398
1943–44	302	380	147	262	373	383	291	334	169	268	326	333
1944–45	188	251	84	171	250	253	226	271	128	208	268	278
1945–46	286	368	130	235	377	381	316	365	187	281	363	369
1946–47	199	252	80	165	245	247	212	245	117	193	246	244
1947–48	236	308	113	209	298	304	259	317	149	234	300	303
1948–49	239	298	104	203	293	298	284	310	161	256	306	310
	GJERPEN											
1940–41	82	102	38	75	98	100	82	92	54	79	89	93
1941–42	94	113	45	88	106	111	75	87	48	70	84	85
1942–43	84	114	41	83	116	117	74	88	44	69	85	88
1943–44	81	97	48	73	97	99	74	82	37	66	79	84
1944–45	76	99	33	59	101	102	81	96	46	72	95	98
1945–46	91	115	33	77	119	120	100	120	68	92	117	119
1946–47	103	137	40	91	138	139	114	135	68	109	134	136
1947–48	103	129	46	92	126	125	105	120	71	100	116	122
1948–49	97	120	49	89	117	118	100	117	63	96	116	120
1951–52	121	164	47	113	154	162	138	168	83	131	166	167
1952–53	153	201	88	144	204	202	166	193	108	154	192	193
	RURAL DISTRICTS											
1940–41	54	66	26	49	63	64	66	80	36	63	79	80
1941–42	37	41	18	36	42	42	42	51	27	37	51	50
1942–43	38	45	16	33	46	45	56	61	27	48	60	60
1943–44	49	71	24	50	72	72	87	102	51	78	104	105
1944–45	68	84	39	61	84	86	88	108	49	80	109	110
1945–46	95	110	52	84	106	107	92	108	43	84	110	108
1946–47	82	93	41	71	89	89	71	88	42	66	85	85
1947–48	61	79	30	59	77	76	61	76	29	62	77	77
1948–49	67	84	34	59	78	79	75	88	36	67	88	89

[1] No examinations in 1948–1949 in Trondheim; and 8 year-old children not examined in 1947–1948.

Table 22a. For 12+13 year old boys in cities, Trondheim, villages, Gjerpen and rural districts, the percentages of specific permanent teeth that were decayed, missing or filled in each year from 1940–1941 to 1948–1949.

School Year	Boys—Per Cent of Teeth DMF													
	Central Incisor		Lateral Incisor		Cuspid		First Bicuspid		Second Bicuspid		First Molar		Second Molar	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
	CITIES													
1940–41	57.8	26.7	59.3	23.8	14.3	6.0	37.2	7.8	39.8	18.2	94.7	97.1	41.2	58.5
1941–42	62.5	22.0	57.8	17.3	11.3	3.1	36.5	3.9	31.4	18.7	98.2	98.8	43.5	66.9
1942–43	50.9	22.3	55.6	19.1	7.7	3.6	25.6	5.4	26.8	14.1	96.1	96.9	46.4	55.9
1943–44	47.4	16.8	49.5	14.1	3.6	0.7	23.9	3.3	22.9	10.0	96.7	98.4	43.3	53.0
1944–45	40.6	12.2	40.3	8.4	1.5	0.3	25.2	2.5	20.2	8.6	95.0	96.9	32.4	47.8
1945–46	34.8	12.2	35.8	7.0	1.4	0.8	20.6	3.3	16.0	7.6	96.3	97.4	38.6	54.8
1946–47	29.5	7.4	31.4	3.7	1.4	0.8	10.7	2.9	8.9	7.9	95.6	95.9	46.3	53.9
1947–48	31.5	6.2	32.1	4.3	3.5	1.1	16.9	0.8	13.1	5.7	90.6	92.8	43.0	57.1
1948–49	40.0	5.3	38.0	3.5	3.6	0	18.7	5.1	19.5	12.1	88.7	90.1	45.0	59.4
	TRONDHEIM[1]													
1941–42	59.6	23.0	65.3	20.1	10.5	3.3	45.4	17.1	37.7	28.4	97.5	97.2	65.1	66.4
1942–43	63.3	25.9	65.2	19.2	10.9	5.2	39.9	13.0	31.1	19.0	97.1	97.9	53.7	60.8
1943–44	56.2	25.3	57.3	15.8	6.6	0	27.3	4.8	23.3	10.6	95.2	98.6	47.3	48.7
1944–45	39.4	23.9	47.4	11.0	4.1	0.7	23.6	5.8	17.3	12.5	96.1	96.8	35.4	43.7
1945–46	33.2	17.1	43.3	5.7	4.9	0.5	23.5	6.2	24.9	13.2	96.7	94.8	47.6	55.9
1946–47	45.5	11.2	45.5	7.5	7.6	1.1	31.8	4.8	34.1	17.2	96.8	97.3	69.4	72.9
1947–48	47.3	11.8	58.7	11.9	11.2	4.8	42.0	5.4	46.3	28.9	99.1	92.7	84.6	88.9
	VILLAGES													
1940–41	58.8	21.3	56.4	17.2	9.7	2.8	33.1	11.9	34.0	27.2	95.9	98.0	59.9	69.0
1941–42	58.3	18.4	58.0	15.0	12.0	3.5	36.2	16.0	36.0	26.9	94.7	97.0	55.0	71.6
1942–43	57.1	19.3	53.3	16.0	5.8	0.8	26.6	10.2	22.4	19.9	95.6	97.5	50.0	58.2
1943–44	49.1	17.8	50.2	15.9	3.1	1.3	20.4	4.1	23.3	13.8	96.4	97.6	54.0	60.1
1944–45	42.8	14.7	42.0	10.6	1.7	0.6	18.4	5.8	19.4	11.7	96.4	97.2	48.7	56.9

1945–46	36.5	9.8	38.2	6.8	2.3	0.5	13.8	3.7	13.0	7.3	95.8	96.5	42.1	51.3
1946–47	33.7	6.8	32.9	3.6	2.5	0.8	14.5	4.5	11.7	10.8	93.6	97.2	49.7	68.3
1947–48	37.5	5.4	37.4	4.1	4.4	1.1	16.1	8.2	19.8	14.8	89.8	93.6	41.9	56.0
1948–49	41.5	4.7	42.0	4.0	8.1	1.1	16.9	7.5	25.0	16.8	83.6	86.9	45.3	56.7
	GJERPEN													
1940–41	64.4	20.7	64.8	16.4	7.2	2.1	24.3	3.6	23.5	17.3	91.8	95.9	52.1	68.3
1941–42	55.1	16.8	56.2	14.5	4.3	0.8	21.6	4.8	12.6	7.0	89.1	89.9	44.4	60.0
1942–43	54.8	16.3	49.3	11.1	3.8	0	23.7	4.9	14.9	6.9	86.7	88.1	31.3	45.5
1943–44	54.8	17.9	43.9	12.6	2.8	0.8	10.9	3.4	10.9	1.9	89.6	88.9	15.6	23.5
1944–45	46.6	13.2	37.0	9.2	1.9	1.6	8.1	1.8	9.9	0	79.4	84.0	14.6	23.3
1945–46	28.7	5.4	21.9	2.3	0	0	3.4	0.9	4.8	2.2	68.5	75.4	8.5	15.8
1946–47	17.4	4.5	17.7	3.0	3.1	0	5.0	0	2.7	4.0	57.9	60.9	7.7	23.0
1947–48	24.2	1.5	23.3	0.8	0	0	1.6	1.7	1.9	2.0	50.0	56.1	3.9	24.0
1948–49	29.4	0.9	24.8	0.9	0	0	7.1	3.2	6.3	5.3	44.0	49.5	11.9	17.9
1951–52	37.8	2.2	35.8	3.9	2.2	0	4.2	1.2	4.3	4.0	52.8	60.6	12.9	26.7
1952–53	39.3	3.5	37.4	4.0	0	0	7.0	0	7.4	1.7	64.2	72.3	12.5	26.0
	RURAL DISTRICTS													
1940–41	64.9	23.0	57.5	17.6	15.4	2.7	33.8	10.3	33.3	21.1	95.9	97.3	60.7	68.3
1941–42	70.7	25.9	63.2	17.2	13.0	3.4	40.4	14.5	44.2	28.6	94.8	96.6	61.9	74.0
1942–43	54.5	22.7	52.4	13.6	5.4	0	36.4	5.0	29.3	17.9	100.0	100.0	47.1	60.0
1943–44	45.7	23.5	40.3	16.0	3.1	2.7	21.9	4.2	23.6	6.9	97.5	100.0	57.4	58.7
1944–45	43.7	17.2	39.0	9.2	2.8	2.4	8.8	1.3	18.2	2.9	98.9	96.6	39.7	52.2
1945–46	39.3	15.7	33.3	6.7	2.7	0	6.0	2.5	12.3	2.9	95.5	93.3	34.9	40.3
1946–47	28.6	7.1	27.1	1.4	5.2	1.4	6.3	1.5	10.0	7.5	91.4	95.7	42.6	40.7
1947–48	17.7	3.2	27.9	3.2	7.5	1.6	18.3	3.8	24.5	15.9	91.9	93.5	50.0	65.5
1948–49	22.4	3.0	24.2	3.0	3.5	0	10.8	1.6	8.6	5.6	88.1	92.5	30.6	63.2

[1] No examinations in Trondheim in 1948–1949; 1940–1941 omitted, values of doubtful accuracy.

Table 22b. For 12+13 year old girls in cities, Trondheim, villages, Gjerpen and rural districts, the percentages of specific permanent teeth that were decayed, missing or filled in each year from 1940–1941 to 1948–1949.

School Year	Girls—Per Cent of Teeth DMF													
	Central Incisor		Lateral Incisor		Cuspid		First Bicuspid		Second Bicuspid		First Molar		Second Molar	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
	CITIES													
1940–41	70.6	27.2	67.2	20.0	18.6	6.1	45.5	12.7	35.7	24.5	97.8	97.8	52.7	71.2
1941–42	68.8	23.3	66.1	18.8	8.6	2.9	39.2	7.1	34.1	26.1	93.8	98.9	49.0	65.6
1942–43	61.0	27.7	57.3	19.5	2.7	3.6	31.8	7.0	32.2	22.4	96.9	98.5	51.0	71.4
1943–44	59.6	23.0	56.2	16.7	4.3	3.7	29.3	6.0	24.5	14.4	96.7	98.5	48.1	73.8
1944–45	57.2	19.6	55.0	13.6	3.1	2.1	26.4	2.2	21.7	10.3	97.3	97.3	50.8	71.5
1945–46	47.6	18.5	47.8	9.9	3.4	1.0	23.4	3.6	19.4	10.1	96.2	99.0	47.5	70.0
1946–47	35.9	14.0	42.7	11.1	3.0	0.4	17.0	4.6	18.3	13.1	94.8	98.5	51.6	66.1
1947–48	39.9	11.6	39.5	7.7	8.0	1.9	22.7	5.7	22.5	17.6	94.5	96.8	52.4	69.6
1948–49	43.3	5.8	39.3	4.3	7.4	2.6	21.1	4.2	22.5	16.2	92.4	94.6	46.9	71.5
	TRONDHEIM[1]													
1941–42	71.5	30.3	73.2	26.8	19.0	5.7	52.1	14.2	46.8	33.3	98.3	98.7	69.9	76.1
1942–43	67.6	35.3	68.1	27.7	17.9	6.9	48.0	12.2	39.3	23.6	97.6	99.6	65.3	72.3
1943–44	62.9	35.9	69.3	29.5	9.9	7.2	35.0	9.7	34.4	21.0	97.6	99.4	66.9	73.2
1944–45	58.6	28.2	55.9	17.3	7.9	4.8	33.3	7.9	30.7	17.4	98.9	98.3	47.2	61.1
1945–46	51.5	25.1	53.0	15.3	5.0	0.9	27.4	6.8	22.3	15.3	98.3	98.3	54.4	60.3
1946–47	59.0	21.5	57.5	16.5	19.4	5.7	42.2	9.1	37.1	22.1	98.5	97.9	78.1	89.3
1947–48[2]														
	VILLAGES													
1940–41	66.3	20.6	61.4	16.0	19.8	6.9	41.3	14.9	43.8	38.3	97.3	98.1	72.0	82.8
1941–42	62.5	20.8	55.1	15.0	15.5	8.4	36.1	14.5	35.6	31.6	97.9	97.9	67.2	81.3
1942–43	61.8	22.5	57.0	13.9	10.8	4.6	27.0	9.3	31.5	21.6	97.8	97.0	58.3	77.9
1943–44	56.7	19.3	55.7	12.0	7.4	2.4	20.5	6.5	27.9	16.4	96.7	99.0	61.6	71.0
1944–45	49.0	19.1	48.8	10.8	4.1	1.4	18.8	5.0	19.4	16.3	97.3	99.0	52.7	64.8

1945–46	46.4	15.3	48.8	10.0	2.4	1.9	18.2	3.0	17.2	10.1	95.8	98.4	43.9	62.0
1946–47	48.0	10.4	44.7	5.9	4.6	0.5	18.4	5.2	18.7	15.1	96.4	98.2	54.4	73.0
1947–48	41.8	4.3	42.2	4.3	5.5	0.7	18.7	4.1	22.0	14.2	90.6	94.2	55.2	66.4
1948–49	47.3	2.7	46.1	1.5	8.5	1.1	21.9	6.4	25.7	18.4	91.3	92.8	46.4	71.0
	GJERPEN													
1940–41	66.2	16.6	55.2	14.6	10.9	6.4	26.8	7.8	27.5	16.8	92.4	94.9	54.8	73.6
1941–42	58.9	19.9	59.3	17.2	9.1	4.8	27.9	7.0	26.1	15.7	90.1	94.7	39.7	69.3
1942–43	55.4	16.9	51.0	14.9	6.0	3.4	25.5	5.7	18.9	9.5	87.8	91.9	25.0	47.4
1943–44	43.9	13.6	38.5	13.0	3.3	2.3	9.2	0.8	9.8	5.2	78.0	87.1	10.3	24.2
1944–45	44.4	15.7	41.2	11.9	4.0	1.5	8.4	2.3	7.4	5.2	79.3	91.1	14.7	26.3
1945–46	38.4	9.0	29.1	5.4	3.0	0.9	4.6	0.9	8.1	2.0	75.0	86.6	12.8	15.5
1946–47	32.1	5.5	19.6	0.9	2.1	0	2.8	1.9	3.3	2.2	74.3	82.6	5.1	13.1
1947–48	38.3	2.1	20.0	0	2.5	0	2.3	1.2	5.4	5.6	57.4	76.6	8.5	21.1
1948–49	32.6	2.1	22.8	1.1	1.2	0	4.6	0	5.9	2.6	38.9	55.8	6.7	20.5
1951–52	35.6	4.0	33.8	3.4	2.3	0	9.7	1.4	3.2	7.0	58.4	73.2	26.5	40.6
1952–53	41.3	4.3	35.6	2.9	3.5	1.4	13.0	2.3	7.3	11.2	71.0	85.5	27.1	45.3
	RURAL RISTRICTS													
1940–41	68.5	18.5	61.1	16.7	22.2	5.6	47.2	11.1	57.1	35.6	100.0	94.4	71.7	84.6
1941–42	71.4	32.1	57.1	23.2	11.5	7.3	53.6	17.0	52.8	38.0	98.2	100.0	57.8	76.5
1942–43	53.2	25.3	49.4	22.8	13.2	5.2	40.8	11.8	36.1	20.6	100.0	100.0	59.1	66.2
1943–44	48.5	19.6	44.1	14.4	9.2	2.1	24.2	6.6	20.5	11.8	95.9	96.9	58.1	65.4
1944–45	43.3	16.5	39.8	13.4	7.1	2.1	19.1	2.3	22.2	14.5	92.8	95.9	40.8	63.2
1945–46	33.3	8.8	33.0	7.8	4.7	1.0	10.4	2.4	19.0	5.6	91.2	96.1	32.4	47.5
1946–47	25.3	2.4	24.7	2.4	4.4	0	13.0	4.3	13.2	10.0	86.7	96.4	41.0	59.4
1947–48	31.9	2.8	35.2	2.8	6.3	0	17.9	2.9	17.2	6.8	87.5	88.9	43.5	71.4
1948–49	31.0	2.4	34.5	2.4	1.4	0	20.3	1.2	17.2	9.3	77.4	86.9	47.5	61.6

[1] No examinations in Trondheim in 1948–1949; 1940–1941 omitted, values of doubtful accuracy.
[2] Only 9 girls age 12 years in 1947–1948.

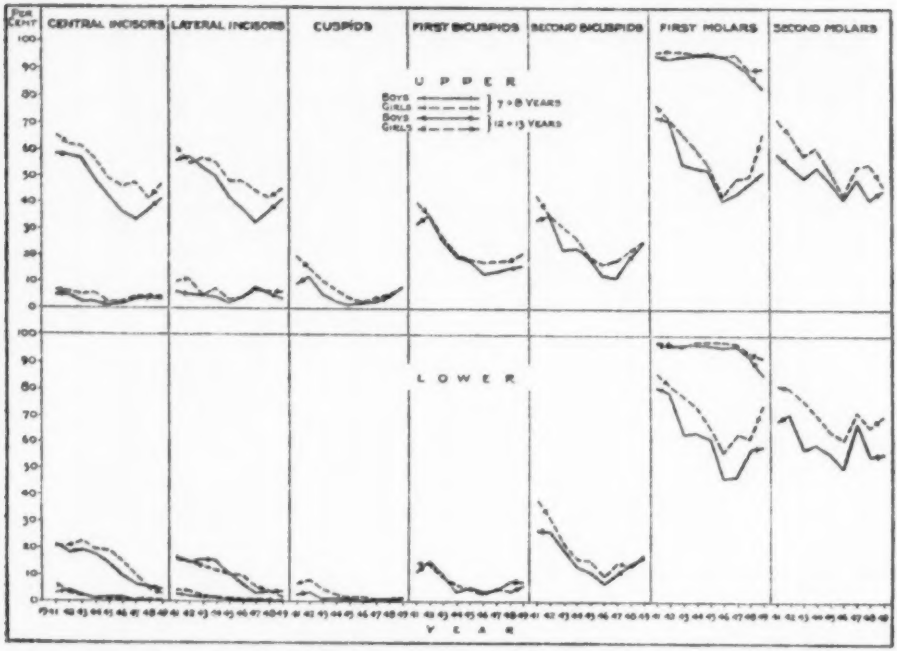


Fig. 26. Percentages of specific permanent teeth DMF at ages 7 + 8 years and 12 + 13 years for boys and girls in villages, 1940–1941 to 1948–1949.

longest post-eruptive age, or the lowest caries rates, usually reach the lowest value late. The first molars are an example of the teeth with long post-eruptive age, and the lower incisors and lower cuspids are representative of the low-caries teeth.

Except for the molars, the mandibular tooth has a lower DMF rate than the corresponding upper tooth; this is in agreement with common findings. Rates for the different bicuspids also vary according to the usual pattern; the first and second upper bicuspids have almost identical DMF rates, whereas in the lower jaw, rates are much lower for the first than for the second bicuspid.

Percentage Reduction in DMF Rates for Specific Teeth. Differences in the maximum percentage reduction from levels in the school year 1940–1941 for DMF rates of corresponding

Table 23. Maximum percentage reduction in the percentages of total and specific permanent teeth DMF in the school-years 1940–1941 to 1948–1949, for 7+8 and 12+13 year-old boys and girls in cities, villages, Gjerpen and rural districts.

(Base year = 1940–1941.)

Age and Specific Tooth	Cities		Villages		Gjerpen		Rural Districts	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
	Maximum percentage reduction in DMF rates							
Age 7+8 Years								
Total Teeth[1]	30.7	35.2	40.7	42.5	83.4	74.0	54.7	59.2
Total Upper[2]	38.5	42.6	42.8	49.1	82.4	75.5	63.9	64.1
Total Lower[2]	31.3	32.7	41.8	38.1	84.5	74.6	47.6	55.7
First Molar								
Upper	36.4	37.8	43.2	46.9	82.2	70.1	54.0	58.6
Lower	27.8	25.0	42.4	34.5	83.3	72.4	39.0	48.9
Age 12+13 Years								
Total Teeth	32.2	27.4	27.8	31.3	63.1	63.7	40.0	43.1
Total Upper	35.1	32.1	30.6	31.1	65.4	63.8	46.9	49.7
Total Lower	29.2	23.4	28.2	32.2	63.0	63.5	35.0	39.1
Central Incisor								
Upper	49.0	49.2	42.7	37.0	73.0	51.5	72.7	63.1
Lower	80.1	78.7	77.9	86.9	95.7	87.3	87.0	87.0
Lateral Incisor								
Upper	47.0	41.5	41.7	31.3	72.7	64.5	57.9	59.6
Lower	85.3	78.5	79.1	90.6	95.1	100.0	92.0	85.6
Cuspid								
Upper	90.2	83.9	82.5	87.9	100.0	89.0	82.5	93.7
Lower	100.0	93.4	82.1	92.8	100.0	100.0	100.0	100.0
First Bicuspid								
Upper	71.2	62.6	58.3	55.9	93.4	91.4	82.2	78.0
Lower	89.7	82.7	68.9	79.9	100.0	100.0	87.4	89.2
Second Bicuspid								
Upper	77.6	48.7	65.6	60.7	91.9	88.0	74.2	76.9
Lower	68.7	58.8	73.2	73.6	100.0	88.1	86.3	84.3
First Molar								
Upper	6.3	5.5	12.8	6.9	52.1	57.9	8.1	22.6
Lower	7.2	3.3	11.3	5.4	48.4	41.2	4.9	7.9
Second Molar								
Upper	21.4	11.0	30.1	39.0	92.5	90.7	49.6	54.8
Lower	18.3	7.9	25.7	25.1	76.9	82.2	41.0	43.9

[1] Includes all permanent teeth.
[2] Incisors and first molars only.

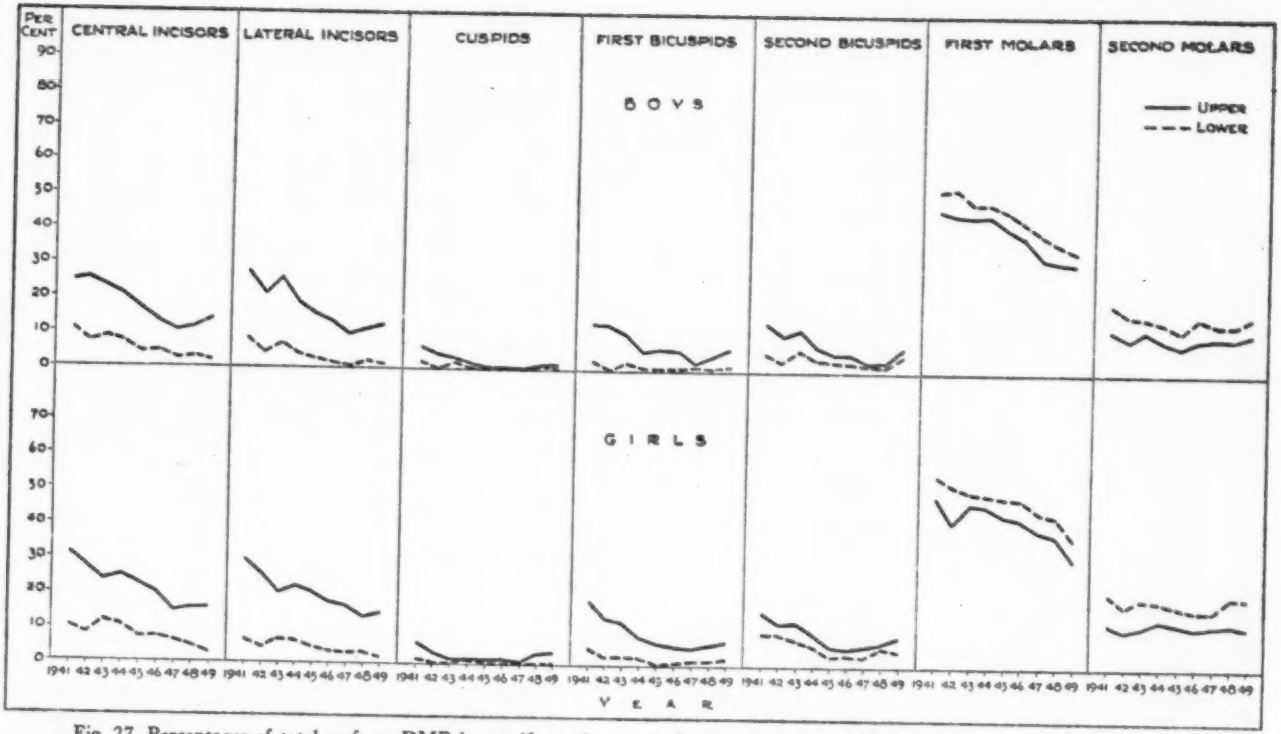


Fig. 27. Percentages of total surfaces DMF in specific teeth at ages 7 + 8 years and 12 + 13 years for boys and girls in cities, 1940–1941 to 1948–1949.

teeth in the upper and lower jaws may be obtained from Table 23. For the ages 7 + 8 years, first molars only have been considered because of the very low caries rates for incisors. In cities, villages, and rural districts, the upper first molars show a greater reduction than the lower ones. In Gjerpen, where the percentage reduction was greatest (70 and 82 per cent for upper first molars and 72 and 83 per cent for lower ones among girls and boys, respectively) there was no real difference between upper and lower molars.

In the 12 + 13 year age group for cities, villages, rural districts, and Gjerpen, the maximum percentage reduction in the DMF rate is higher for the mandibular incisors, cuspid, and bicuspids than for the corresponding maxillary tooth with the exception that boys in villages and in Gjerpen had the same reduction for upper and lower cuspids and in cities had a higher reduction for upper than lower second bicuspids and girls in Gjerpen had the same reduction for upper and lower second bicuspids. For the first and second molars, the reverse is true, and the reduction in the DMF rate is usually much greater for the maxillary than for the mandibular tooth. In general, the tooth with the lowest susceptibility to caries shows the largest percentage reduction.

DMF Surfaces for Specific Teeth. Differences in caries rates for specific teeth in the upper and lower jaw and the relative changes in caries rates for corresponding teeth during the period 1941 to 1949 are demonstrated more clearly by rates for tooth surfaces affected by caries. For each tooth, the total number of surfaces is the base population (number of erupted teeth times number of surfaces of the specific tooth) and the percentage of these surfaces that were affected by caries is computed. For incisors and cuspids, four surfaces are counted; and for bicuspids and molars, five surfaces. Roots present are counted as having all surfaces carious; and any extracted tooth or artificial crown is counted as having three carious surfaces. Rates for carious surfaces in specific teeth of 13 year-old boys and girls are plotted in Fig. 27 for children in the cities and in

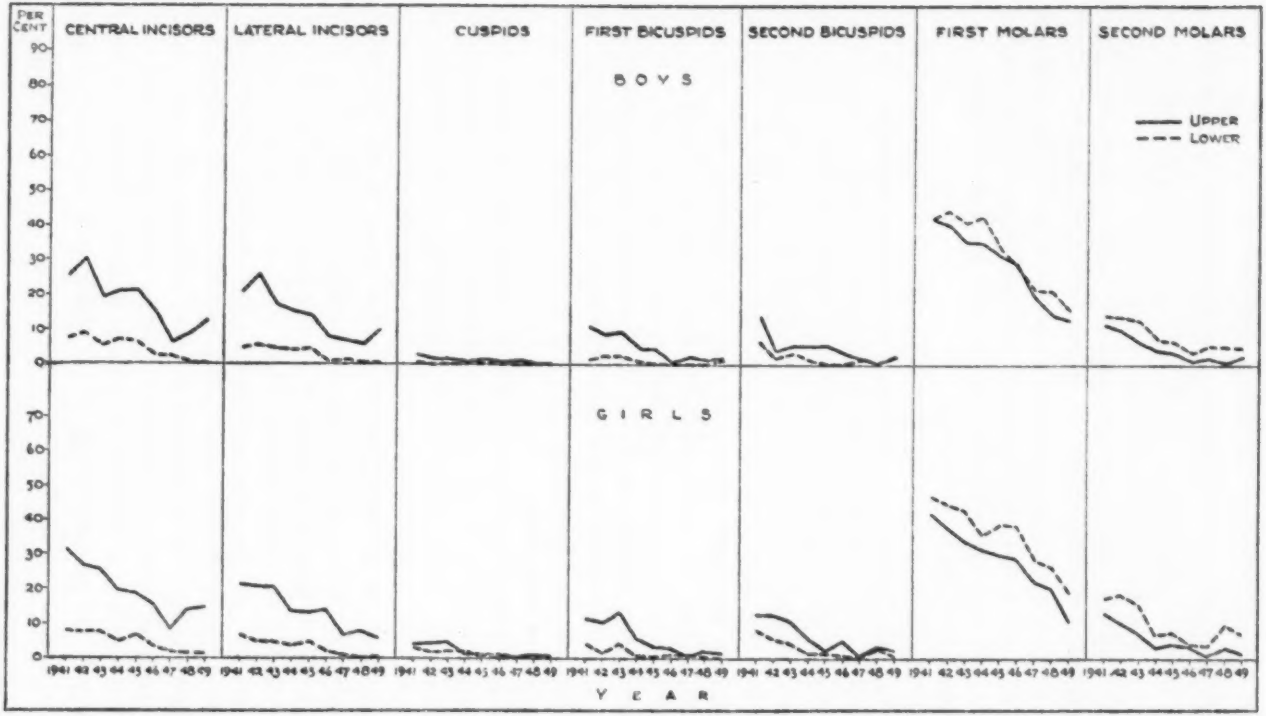


Fig. 28. Percentages of total surfaces DMF in specific teeth at ages 7 + 8 and 12 + 13 years for boys and girls in Gjerpen, 1940–1941 to 1948–1949.

Fig. 28 for children in Gjerpen, and are shown in Table 24a and Table 24b.

For corresponding teeth in the upper and lower jaws, the same relative caries status based on surfaces affected is shown in Figs. 27 and 28 as was noted for percentages of teeth DMF. The incisors, cuspid, and bicuspids in the upper jaw have higher percentages of surfaces carious than the corresponding tooth in the lower jaw, but the reverse condition is found for first and second molars. DMF surface rates for the lower molars exceed those for the upper molars less relatively than the surface rates for other teeth in the upper jaw exceed those for the corresponding tooth in the lower jaw.

It is clearly evident in Figs. 27 and 28 that the percentage of DMF surfaces in individual teeth was greatly reduced during and after World War II. With a few exceptions, the decrease in rates for surfaces was already apparent at the examinations in 1941–1942 and continued for a varying number of years. For the first molars, and also for the lower incisors, rates were still decreasing at the end of the period, 1948–1949, both in cities and in Gjerpen. The upper central incisors in both community groups, and upper cuspid and bicuspids in cities show an upturn in rates in 1947 or 1948. In Gjerpen, the curves are nearly horizontal in the latter part of the period for upper and lower cuspids and bicuspids.

Permanent First Molars DMF and Extracted. A comparison between the percentage of permanent first molars DMF and the percentage extracted (M) is demonstrated in Table 26 and Fig. 31 for cities, Trondheim, villages, and Gjerpen. As is seen, the extraction rate is higher in the lower than in the upper jaw in all districts. A very pronounced decrease in extraction of upper and of lower teeth took place from the start to the end of the period. In Gjerpen, for instance, the rate in 1940–1941 was from 38 to 47 per cent and in 1948–1949 it was zero for boys and for girls. The DMF rates were lower in this district than in any of the others, and the rate of extractions is also the least except for a few annual rates in the early part

Table 24a. For 13 year-old boys,[1] the percentage of surfaces carious in specific permanent teeth in cities, villages and Gjerpen, 1940–1941 to 1948–1949.

School Year	Per Cent of Surfaces DMF[2] for Specified Tooth													
	Central Incisor		Lateral Incisor		Cuspid		First Bicuspid		Second Bicuspid		First Molar		Second Molar	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
	CITIES													
1940–41	24.5	10.9	27.7	8.5	6.6	2.5	13.2	3.3	14.3	6.0	46.8	52.0	12.5	20.0
1941–42	25.4	7.3	21.5	4.2	4.8	0.8	12.9	0	11.3	3.3	45.2	52.6	9.8	16.8
1942–43	23.1	8.7	26.3	7.2	3.4	2.3	10.5	2.6	12.3	6.7	44.7	48.5	12.5	16.0
1943–44	20.5	7.1	19.1	4.2	1.9	0.3	5.8	1.0	7.2	3.9	45.3	48.4	9.4	14.4
1944–45	16.6	4.1	15.6	2.6	0.5	0	6.5	0.8	5.7	3.5	41.7	46.6	7.9	12.1
1945–46	13.0	4.6	13.4	1.9	0.6	0.1	6.0	0.8	5.4	2.7	38.6	42.7	8.8	14.8
1946–47	10.4	2.5	9.9	0.8	0.6	0.3	2.2	1.1	3.0	2.2	32.8	39.2	10.5	14.1
1947–48	11.5	3.0	11.2	2.0	1.3	0.6	4.4	0.1	3.5	1.9	31.8	36.7	10.2	14.1
1948–49	14.3	1.9	12.9	1.2	1.8	0	6.5	1.4	7.8	4.4	31.6	34.6	11.8	16.4
	VILLAGES													
1940–41	24.2	9.2	21.9	6.5	3.1	0.8	10.8	4.2	13.1	11.4	47.5	53.3	14.9	19.7
1941–42	25.9	7.6	24.8	5.0	4.7	1.4	14.6	5.8	19.0	10.1	47.2	50.6	13.9	19.0
1942–43	24.7	7.6	20.8	4.5	1.9	0.2	10.1	3.4	9.5	7.3	48.0	51.9	13.6	16.8
1943–44	21.0	7.6	18.8	5.3	1.2	0.5	6.4	1.2	8.3	3.7	47.2	47.9	11.3	15.7
1944–45	16.4	6.4	14.6	3.4	0.4	0	5.7	1.4	6.2	3.4	45.2	46.4	12.0	16.1
1945–46	16.1	5.2	14.9	3.0	0.5	0.1	5.6	1.1	5.2	2.2	41.6	43.6	10.3	13.0
1946–47	12.2	2.3	12.5	0.8	1.5	0.8	3.7	0.5	3.5	3.1	34.9	39.8	12.2	17.0
1947–48	15.0	1.7	11.9	1.0	1.9	0.5	4.2	2.0	5.8	4.0	38.0	39.3	12.3	15.6
1948–49	14.4	3.4	13.9	2.4	2.5	0.5	5.5	1.6	8.4	5.1	32.6	34.3	11.0	14.5
	GJERPEN													
1940–41	25.6	7.4	20.7	4.9	2.7	0.6	10.9	1.7	14.4	7.0	42.0	42.2	11.7	14.4
1941–42	30.6	9.1	26.2	5.6	1.3	0	8.6	2.9	4.1	2.1	40.6	44.8	10.2	14.3
1942–43	19.1	5.3	17.0	4.3	1.6	0	9.7	2.5	5.6	3.5	35.8	41.1	6.6	12.8
1943–44	21.0	7.2	15.3	4.0	0.8	0	5.1	0.7	5.5	1.1	35.4	42.9	4.3	7.2
1944–45	21.2	6.3	14.1	4.5	1.6	0.7	4.7	0.6	5.9	0	31.7	33.3	3.5	6.6
1945–46	15.3	2.5	7.9	0.8	0	0	0.7	0.4	3.3	0	29.5	28.8	1.0	3.6
1946–47	6.3	2.4	6.9	1.4	1.2	0	2.9	0	2.2	1.9	19.2	21.7	2.3	5.7
1947–48	9.0	0	5.8	0	0	0	1.6	0	0	0.4	14.3	21.5	0.5	5.4
1948–49	12.8	0	10.2	0	0	0	2.2	1.8	2.9	3.2	13.1	15.9	2.9	5.1
1951–52	14.7	0.9	11.9	1.3	1.4	0	2.7	1.1	1.6	2.3	14.5	22.5	3.0	5.4
1952–53	13.5	2.0	13.4	2.0	0	0	2.8	0	3.8	1.1	22.5	27.2	2.8	5.7

[1] Numbers of boys examined are shown in Table 26. Not all teeth are erupted at age 13 years, especially the second molars.
[2] Three carious surfaces counted for an extracted tooth.

Table 24b. For 13 year-old girls[1] in cities, villages and Gjerpen, the percentages of total surfaces carious in the specific permanent teeth, in 1940–1941 to 1948–1949.

School Year	Per Cent of Surfaces DMF[2] for Specified Tooth													
	Central Incisor		Lateral Incisor		Cuspid		First Bicuspid		Second Bicuspid		First Molar		Second Molar	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
	CITIES													
1940–41	31.7	10.3	29.4	6.7	6.6	1.7	18.9	4.7	14.1	9.1	49.1	55.3	12.8	21.5
1941–42	27.7	8.0	25.8	4.4	3.1	0.3	13.5	2.9	12.6	9.0	41.8	52.3	10.7	17.6
1942–43	23.9	12.1	20.1	6.9	1.2	0.8	12.1	2.4	12.9	7.5	47.5	50.5	11.8	20.0
1943–44	25.1	10.8	22.3	6.7	1.4	1.2	8.2	2.3	9.8	6.0	46.4	49.8	14.1	19.2
1944–45	22.8	7.3	20.7	4.5	1.1	0.5	6.5	0.8	5.9	3.1	43.6	48.9	12.8	17.9
1945–46	20.2	7.5	17.9	3.7	1.4	0.4	5.9	0.4	5.3	3.1	42.7	48.4	10.8	15.6
1946–47	14.4	6.3	16.7	3.2	1.0	0.2	5.0	1.4	5.8	2.8	39.6	44.9	12.4	16.5
1947–48	15.4	4.7	13.4	3.4	3.4	0.7	5.8	1.8	6.7	5.5	38.2	43.9	13.1	20.7
1948–49	15.9	2.5	14.9	1.7	3.6	0.7	7.1	1.8	8.3	4.5	31.3	36.6	12.0	20.6
	VILLAGES													
1940–41	27.3	7.4	25.2	5.9	8.3	2.1	16.2	5.0	19.1	14.1	45.4	51.2	19.5	27.3
1941–42	28.5	8.6	22.2	5.5	5.7	3.1	13.5	5.8	14.2	12.2	48.0	53.3	16.7	22.4
1942–43	24.7	8.7	23.5	4.7	4.2	1.3	11.0	3.6	12.4	8.3	48.1	51.6	15.8	20.7
1943–44	24.9	8.4	22.5	4.5	3.5	0.7	7.2	2.3	12.3	6.0	49.3	53.6	14.6	19.7
1944–45	20.7	8.2	19.0	4.2	1.4	0.5	6.7	1.7	6.8	5.6	48.4	50.1	13.2	16.3
1945–46	16.9	7.0	16.7	3.9	0.7	0.9	5.2	0.8	5.6	2.4	45.7	46.9	9.9	13.2
1946–47	20.4	5.6	19.8	3.2	1.1	0.2	6.9	2.0	4.4	4.9	44.3	50.5	13.1	20.0
1947–48	16.3	1.7	13.5	1.6	2.1	0.2	6.9	1.1	8.5	4.6	35.2	40.4	15.6	18.9
1948–49	16.1	1.1	15.2	0.5	3.2	0.2	7.5	1.9	11.2	7.5	33.0	38.3	12.4	20.0
	GJERPEN													
1940–41	31.9	8.1	21.3	6.6	4.2	3.0	11.4	4.1	12.8	8.1	42.4	47.0	13.4	17.7
1941–42	26.6	7.4	20.5	4.8	4.5	1.9	10.3	1.6	12.9	6.0	37.9	44.9	10.5	18.9
1942–43	25.9	7.6	20.7	4.9	4.8	2.5	13.8	4.2	11.2	4.8	33.9	42.9	7.7	15.6
1943–44	19.7	4.9	13.5	3.8	1.3	1.6	5.9	1.0	6.2	1.5	31.5	35.7	3.4	7.0
1944–45	18.8	6.9	13.2	4.9	1.5	0.7	3.3	0.6	2.9	1.9	30.3	38.9	4.5	7.7
1945–46	15.8	3.4	14.0	1.7	1.3	0.4	3.1	1.0	5.3	1.1	29.0	38.3	3.8	4.2
1946–47	8.2	1.9	6.4	0.5	0.5	0	0	1.2	0.4	0.9	22.3	28.5	1.0	3.8
1947–48	14.2	1.1	8.1	0	1.2	0	2.3	0.5	3.9	2.6	20.5	26.8	3.4	10.0
1948–49	14.4	1.1	5.7	0.5	0.6	0	1.3	0	2.5	1.0	10.6	18.7	1.7	7.0
1951–52	13.3	1.1	10.2	0.8	0.8	0	2.2	0.6	0.3	3.7	19.7	26.7	6.2	9.5
1952–53	12.9	2.5	9.1	1.4	0.8	0.4	5.0	0.6	2.3	3.1	21.1	35.7	7.7	10.9

[1] Numbers of girls examined each year are shown in Table 26. Not all teeth are erupted at age 13 years, especially second molars.
[2] Three carious surfaces counted for each extracted tooth.

of the period. The highest percentage of extractions is found in Trondheim. Cities and villages had very similar extraction rates throughout the period.

The big difference in extraction rates among the various districts may depend not only on the difference in degree of destruction of the molar, but also on the attitude of the dentist towards extraction of the permanent first molar when it *can* be saved.

The pronounced decrease in the per cent of first molars extracted during the period is, of course, a consequence of less carious destruction; but it may also partly be caused by the dentist being able to give more time to preserving this molar as a result of the decrease in caries rates for all teeth.

Sex Differences in Caries Rates

Comparison of the various measures of caries in the teeth of boys and of girls of the same chronological age and in the same year of examination has shown that the girls nearly always had a higher DMF rate than the boys. The difference may increase with advancing age, and usually is greater for teeth in the lower jaw than for those in the upper jaw. For the age group 7 + 8 years, the sexes do not differ very much when the caries rate is expressed as the number of DMF teeth per 100 total erupted permanent teeth (Table 19). However, when the caries rate is expressed as the number of DMF teeth per child (Table 18), the sex difference is very evident. In this age group, the sex difference is also clearly apparent in the DMF percentages for first permanent molars which contribute a very large portion of the total rate (Table 21a).

At ages 12 + 13 years, a definite sex difference is evident whether the rate is expressed as an average number of DMF teeth per child or as a percentage of total teeth DMF. The caries rate in all districts is higher for girls than for boys and, except in Gjerpen, is higher in every year of observation.

The difference between caries rates for boys and girls is not the same for each individual tooth, as may be seen in Fig. 26.

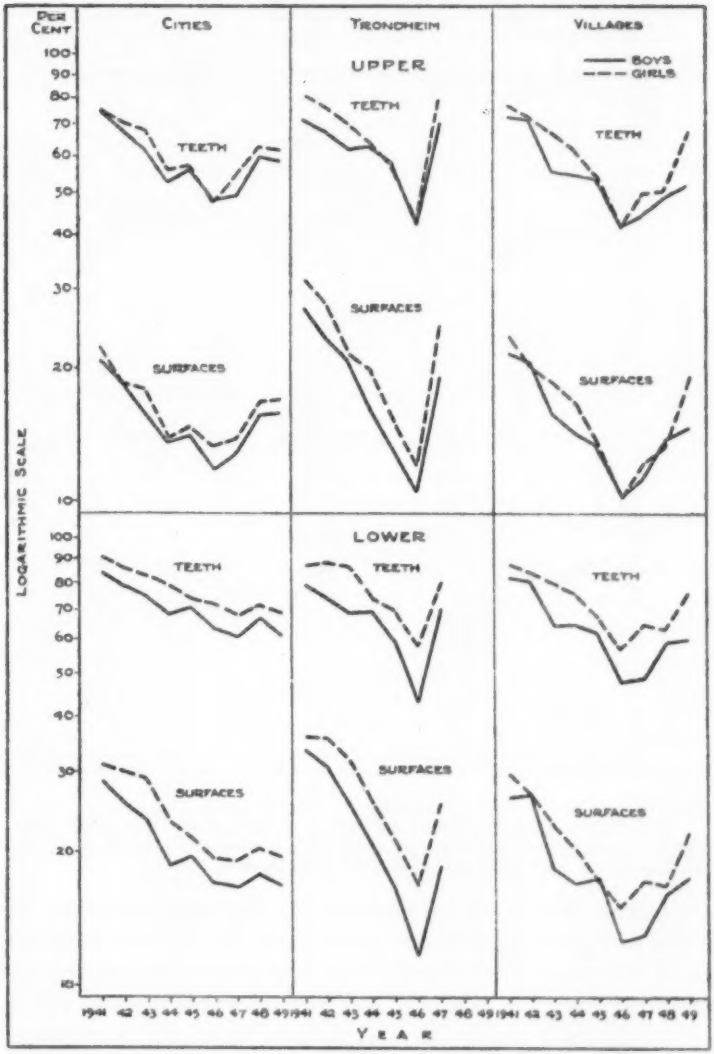


Fig. 29. For permanent first molars, the percentage of teeth DMF and percentages of surfaces DMF for boys and for girls aged 7+8 years in cities, in Trondheim and in villages, 1940–1941 to 1948–1949.

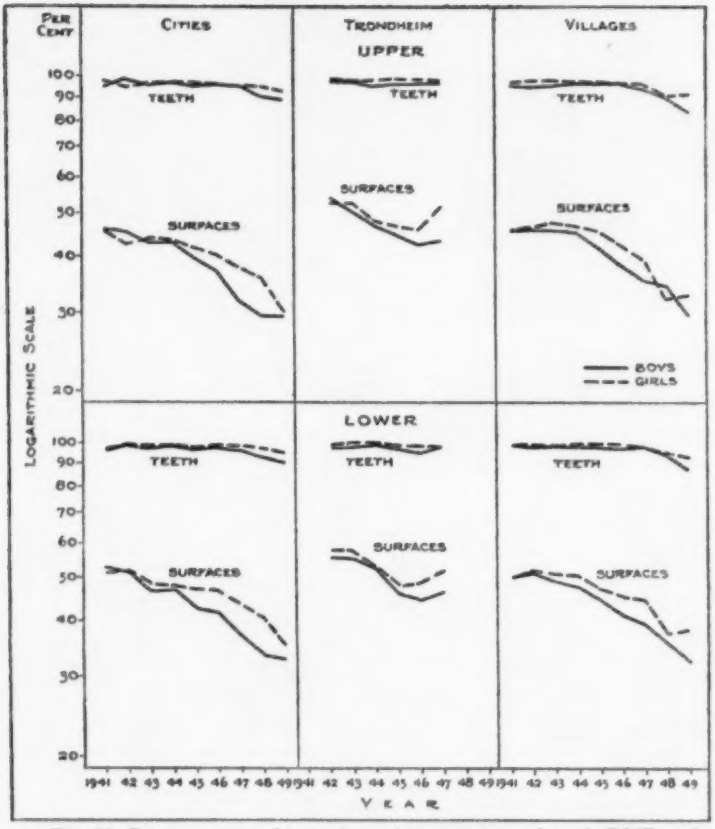


Fig. 30. For permanent first molars, the percentage of teeth DMF and percentage of surfaces DMF for boys and for girls aged 12 + 13 years in cities, in Trondheim and in villages, 1940–1941 to 1948–1949.

The largest differences are found for the upper incisors and second molars at ages 12 + 13 years, and for the first molars at ages 7 + 8 years. For the incisors, the sex difference is much greater at ages 12 + 13 years than at 7 + 8 years whereas the reverse situation holds for the first molars. In the older age group, there are only slight but persistent sex differences in the caries rates for first molars.

As pointed out above, the sex difference is not the same for

Table 25. Percentage of surfaces DMF[1] for permanent first molars of boys and girls aged 7+8 years and 12+13 years in cities, Trondheim and villages, 1940–1941 to 1948–1949.

School Year	Per Cent of Surfaces DMF for Specified Molar							
	7+8 Years[2]				12+13 Years[3]			
	Boys		Girls		Boys		Girls	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
	CITIES							
1940–41	20.9	28.6	22.4	31.1	45.8	53.0	45.6	51.3
1941–42	18.7	25.2	18.6	30.0	45.0	51.3	42.5	51.7
1942–43	16.0	23.2	18.0	29.0	42.8	46.5	43.9	48.6
1943–44	13.7	18.7	14.1	23.1	43.0	47.0	43.5	48.0
1944–45	14.2	19.6	14.8	21.4	39.3	43.1	41.6	47.2
1945–46	11.8	17.0	13.4	19.3	37.0	41.5	40.0	46.8
1946–47	12.9	16.6	13.9	19.1	31.7	37.1	37.7	43.7
1947–48	15.8	18.0	17.0	20.5	29.3	33.5	35.8	41.0
1948–49	15.9	16.9	17.1	19.5	29.3	33.0	30.0	35.0
	TRONDHEIM[4]							
1940–41[5]	27.2	33.2	31.6	36.1				
1941–42	23.1	30.8	27.3	35.6	53.6	55.7	52.6	57.7
1942–43	20.6	25.3	21.5	31.8	50.3	55.1	52.6	57.5
1943–44	16.1	20.5	19.7	25.5	46.3	52.1	47.8	52.2
1944–45	13.2	16.3	15.0	21.1	44.3	45.9	46.4	47.6
1945–46	10.5	11.6	12.1	16.8	42.2	44.2	45.7	48.7
1946–47	19.3	18.6	24.9	25.6	43.3	46.0	51.6	51.4
1947–48[6]					43.8	43.3		
	VILLAGES							
1940–41	21.7	26.1	23.6	29.4	45.5	50.0	45.6	49.8
1941–42	20.6	26.8	20.3	26.7	45.9	51.0	46.5	51.8
1942–43	15.7	18.3	18.7	22.8	45.8	48.7	47.6	50.6
1943–44	14.4	17.0	16.9	20.2	45.3	47.2	46.9	50.6
1944–45	13.5	17.5	13.7	17.1	42.0	44.2	45.5	47.0
1945–46	10.3	12.5	10.2	15.0	38.2	41.1	42.3	45.2
1946–47	11.5	12.9	12.3	17.2	35.4	39.3	39.2	44.4
1947–48	13.9	16.1	13.3	16.6	34.2	35.6	32.1	37.1
1948–49	14.9	17.5	19.3	22.0	29.5	32.2	32.7	38.1

[1] Three carious surfaces counted for each extracted tooth.
[2] Number of erupted first molars shown in Table 21b.
[3] Number of children examined shown in Table 18.
[4] No examinations in 1948–1949.
[5] Values for 12+13 year old group omitted; erratic variations suggest doubtful accuracy.
[6] Eight-year old boys and girls, and 12 year-old girls not examined.

teeth in the upper and lower jaws. This is illustrated for first molars in Fig. 29 and Fig. 30 in which DMF rates have been plotted on a logarithmic scale so that an equal vertical distance between two points represents the same percentage difference. For the age group 7 + 8 years, (Fig. 29) the sex differences for upper first molars are very small, or absent, in most years, but for the lower molars, rates for DMF teeth for girls are consistently higher and the excess ranges from 4 to 15 per cent in cities and from 4 to 33 per cent in villages. The percentages for carious surfaces (Table 25) show approximately the same sex differences as the DMF rates for teeth. At ages 12 + 13 years (Fig. 30), nearly all first molars are carious in both upper and lower jaws of boys and of girls. The percentages of all surfaces affected with caries are higher for girls, but differences between the sexes are fairly equal for upper and lower first molars.

The sex difference is also demonstrated by the extraction rate for first molars, shown in Fig. 31 and Table 26 for 13-year old boys and girls. In cities, Trondheim, and villages, the percentages of first molars extracted are higher for girls than for boys for nearly every year 1941 to 1949, and the differences are larger for lower than for upper teeth. In Gjerpen, the differences by sex in extraction rates is less than in the other communities and rates for girls are not consistently higher.

Is the higher caries rate for girls due to a longer post-eruptive age of the teeth in girls of a specific chronological age than in boys of the same age, or is it due to a true sex factor?

In these studies, as in others, girls show an earlier eruption of the permanent teeth than boys. According to Hurme (1949), taking all 28 teeth together, the average difference in eruption time between the sexes is 0.45 years (5.3 months). This is in good agreement with the findings of Sloman (1941). Hurme states that the sex difference for specific teeth varies from 2.16 months (the maxillary first molar) to 11.16 months (the mandibular canine).

At ages 7 and 8 years, only the first molars and incisors, at

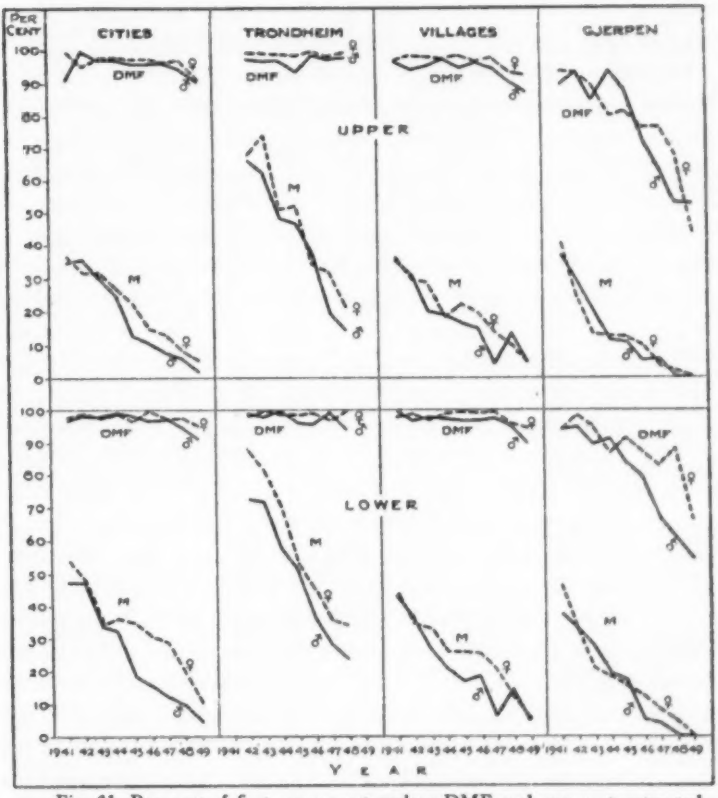


Fig. 31. Per cent of first permanent molars DMF and per cent extracted (M) at age 13 years for boys and for girls, 1940–1941 to 1948–1949.

most, normally are erupted. Using Hurme's figures, the difference in eruption time of these teeth would be 3.66 months, 3.64 for the lower teeth and 3.68 for the upper. With this large difference in post-eruptive age, we did not find in this age group that the percentage of erupted teeth DMF was consistently higher for girls than for boys, although the sex difference was clearly apparent when average numbers of DMF teeth per child were compared. Also, when only first molars are considered, a marked sex difference in caries rates was demonstrated for the lower jaw and a smaller and somewhat irregular difference

Table 26. For 13 year-old boys and girls, per cent of permanent first molars DMF and the per cent extracted (M) in cities, Trondheim, villages and Gjerpen, 1940–1941 to 1948–1949.

School Year	Number of Boys	Boys				Number of Girls	Girls			
		Upper First Molars		Lower First Molars			Upper First Molars		Lower First Molars	
		Per Cent of Teeth					Per Cent of Teeth			
		DMF	(M)	DMF	(M)		DMF	(M)	DMF	(M)
	CITIES									
1940–41	103	91.3	35.0	97.1	47.6	90	100.0	36.7	97.8	54.5
1941–42	65	100.0	35.4	98.5	47.7	91	95.6	33.0	98.9	48.4
1942–43	118	97.5	30.5	98.3	33.9	91	97.8	31.9	97.8	34.1
1943–44	174	97.7	25.9	98.9	32.2	171	98.2	27.5	98.8	36.3
1944–45	164	96.3	12.8	98.2	18.9	191	97.4	23.0	96.9	34.6
1945–46	185	96.2	10.8	96.8	15.7	191	97.4	15.2	99.5	30.4
1946–47	149	96.6	8.1	97.3	12.1	139	96.4	13.7	97.1	28.8
1947–48	176	94.9	6.3	94.9	9.7	179	97.2	8.4	97.8	20.1
1948–49	171	91.2	1.8	91.2	4.7	151	91.4	5.3	94.7	10.6
	TRONDHEIM[1]									
1941–42	120	97.5	66.7	99.2	72.5	141	99.3	68.1	98.6	87.9
1942–43	148	97.3	62.8	98.0	71.6	148	99.3	74.3	100.0	81.8
1943–44	74	97.3	48.6	100.0	58.1	92	98.9	51.1	98.9	70.7
1944–45	85	94.1	47.1	96.5	51.8	84	98.8	52.4	98.8	53.6
1945–46	96	99.0	37.5	95.8	36.5	110	100.0	34.5	99.1	45.5
1946–47	135	97.8	20.0	99.3	28.1	139	98.6	32.4	97.1	35.3
1947–48	67	98.5	14.9	94.0	23.9	79	100.0	21.5	100.0	34.2
	VILLAGES									
1940–41	165	97.0	35.8	99.4	43.3	145	97.2	36.6	97.9	44.1
1941–42	145	94.5	31.0	96.6	35.9	137	98.5	29.9	98.5	34.3
1942–43	165	95.8	20.6	97.6	26.7	155	98.1	29.0	96.8	32.9
1943–44	193	97.9	19.2	97.4	20.7	178	97.8	18.5	98.9	25.8
1944–45	190	95.3	16.8	96.8	16.8	167	98.8	22.8	99.4	25.7
1945–46	228	96.9	15.4	96.9	18.4	188	97.3	20.2	98.9	25.0
1946–47	129	95.3	3.9	97.7	6.2	103	98.1	13.6	99.0	20.4
1947–48	150	90.6	14.1	95.3	14.8	143	93.7	10.6	95.8	12.0
1948–49	155	87.7	4.5	89.7	4.5	140	92.9	4.3	94.3	5.0
	GJERPEN									
1940–41	82	90.2	37.8	93.9	37.8	83	94.0	41.0	94.0	47.0
1941–42	63	93.7	30.2	95.2	33.3	78	93.6	25.6	98.7	32.1
1942–43	76	85.5	21.1	89.5	27.6	82	89.0	13.4	95.1	20.7
1943–44	69	94.2	11.6	91.3	18.8	61	80.3	13.1	86.9	18.0
1944–45	72	88.9	11.1	83.3	16.7	72	81.9	12.5	91.7	15.3
1945–46	59	72.9	5.1	79.7	5.1	60	76.7	10.0	86.7	11.7
1946–47	72	63.9	5.6	66.7	4.2	52	76.9	3.8	82.7	7.7
1947–48	67	53.7	0	61.2	0	44	68.2	2.3	88.6	4.5
1948–49	49	53.1	0	55.1	0	47	44.7	0	66.0	0

[1] No examination in 1948–1949, and 1940–1941 values omitted because of doubtful accuracy.

for the upper jaw. Hurme's figures for the difference in eruption time for upper first molars is 2.16 months and for the lower is 3.24 months. This difference points in the same direction as our observed difference in the caries rate.

At ages 12 + 13 years, the DMF rates for all erupted permanent teeth were consistently higher for girls than for boys in the different communities. The sex differences are approximately equal for teeth in the upper and lower jaws, although according to Hurme, the average difference in eruption time for the lower teeth is 6.03 months and for the upper teeth is 4.65 months.

Among the many authors who have commented on the higher caries rate in girls as compared to boys of the same chronological age, Klein and Palmer (1938) should be mentioned. On the basis of their estimates of the "Post-eruptive Tooth Age" of 2,232 boys and 2,184 girls aged 6 to 16 years (Palmer, Klein and Kramer, 1938) they concluded that the greater post-eruptive tooth age of the girls, with a consequently longer period of risk of caries attack than the boys, is the cause of this difference. Thus, they conclude, susceptibility to attack by dental caries is no greater for girls than for boys. Finn (1952), reviewing the extensive literature on this subject, also attributes the higher caries rate in women, compared to that of men of the same chronological age, to the longer post-eruptive age of their teeth.

The present author has great difficulty in accepting this view. During the first post-eruptive years it would be natural to assume that a difference of 3 to 5 months in post-eruptive age would affect the caries picture quantitatively. However, the influence of this difference in eruption time would be expected to decrease year by year and be totally eliminated in adults. In the review by Finn mentioned above, the sex difference in caries rate was shown to have been demonstrated in numerous studies in population groups up to more than 60 years of age.

Sloman (1941) concludes from his extensive studies on the relationship of caries rates for boys and girls that the earlier

eruption of teeth in girls than in boys "can be but a small factor in the higher incidence of caries in young women as compared with young men." Hewat and Eastcott, in their studies on dental caries in New Zealand children, have similarly compared the caries experience of boys and girls aged 12 to 17 years. Besides basing their comparisons on grouping by chronological age they have also taken into account "post-eruptive tooth-surface years of mouth experience." Even by using this last method they have found a caries rate higher in girls than in boys, and hence concur in the conclusion reached by Sloman. The present author is of the same opinion.

Of special pertinence in these studies is the question of sex differences in caries rates—whatever the full explanation for these may be—in relation to a changing caries picture in a given population. Reductions in caries prevalence may vary by sex, by age, by school year, by community group, and also by type of tooth or surface involved. The changes (trends) over the period of the study were of primary importance here, and the possibility of a sex difference in changes in different school-year periods was considered. A preliminary study of this phase of the caries problem, for 8 and 13 year old children, respectively, and dealing only with the principal permanent teeth of interest here, was made in several of the community groups (cities, villages and Gjerpen). No consistent differences that would demonstrate a clearly defined sex differential rate of reduction in caries were found, and details of this investigation will not be given.

In the preliminary reports on this study (Toverud) the children were grouped not according to their chronological ages but according to the numbers of permanent teeth erupted. This was based on the following facts: (1) The caries risk is dependent upon the post eruptive age of the tooth. (2) The emergence of the permanent teeth in girls is earlier than in boys. (3) The emergence of permanent teeth in both sexes was found to be "retarded" during the war—and early post-war period—compared with the first war-year. The reason for

changing the basis for grouping to chronological age in the final report rather than the number of erupted teeth was mainly for the sake of better comparison with other studies.

Comparison of Changes in Prevalence of Dental Caries in Different Types of Communities, 1940–1941 to 1948–1949

One objective of these studies was to relate any changes in dental health status of the children that might occur during the war years to differences in living conditions of the populations in the various types of communities studied, especially to differences in the ease with which farm products could be obtained during the rationing period. We were particularly interested in comparing city children with rural children as it was natural to expect that the rationing of food would restrict the use of farm products more in cities than in rural areas.

In the foregoing discussion, data from four principal community groups, namely, cities, Trondheim, villages, and Gjerpen, have been considered and some differences for these groups have been suggested as well as the marked similarity in general trends for most of the period of study. For these communities and for combined rural districts and several separate communities previously omitted for special reasons, direct comparisons of different measures of dental caries will now be discussed in more detail.

Total DMF Rates in Different Communities. In Fig. 32, the percentages of total erupted permanent teeth that were decayed, missing or filled are compared for boys and for girls aged 7 + 8 years and 12 + 13 years in each of the four major community groups and in the rural districts. As is easily seen in Fig. 32, the DMF rates for each specific sex-age group are nearly the same at the beginning of the study in cities, villages, and rural districts. The initial values for Gjerpen are lower and those for Trondheim somewhat higher than rates for the other community groups.

At ages 7 + 8 years, in all districts the curves show a decline from the first year and reach the lowest level in 1945–1946.

After 1946, the curves all rise again. The final values in 1948–1949 in cities, villages, and rural districts are nearly the same for boys and quite similar for girls. In fact, the curves for cities and villages are practically identical throughout the period 1941–1949 except for 1946–1948 for boys and 1948 for girls. In the rural districts, the DMF rates for boys and for girls between 1944 and 1947 are definitely lower than those for boys and girls in cities, villages, and Trondheim. The curves for Trondheim are higher than those for any group except in 1945–1946; and rise more sharply after 1946 than the curves for other groups. Unfortunately, the population examined in Trondheim varied from year to year, which may account for some irregularities in rates, and examinations were stopped completely in 1948–1949. In Gjerpen, where the DMF rate at the beginning of the period was lower than in any other community group, the decrease in rates to 1946 was approximately equal to the decrease in rural

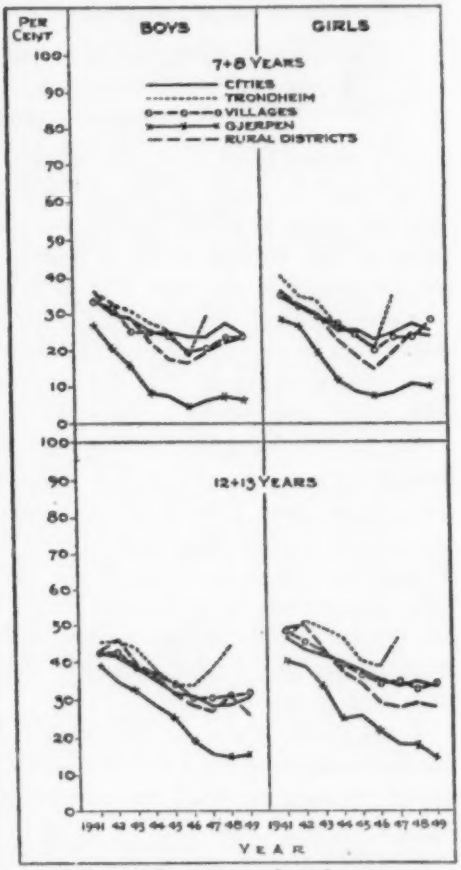


Fig. 32. Percentages of total permanent teeth DMF at ages 7 + 8 years and 12 + 13 years compared for various community groups, 1940–1941 to 1948–1949.

districts. However, the increase after 1946 is less than in rural and other districts.

The *percentage* reduction in total DMF rates, shown in Table 23, is greatest in Gjerpen with 83 and 74 per cent for boys and girls aged 7 + 8 years, respectively. The reduction is next highest in rural districts, 55 and 59 per cent for boys and girls respectively; in third place are the villages with 41 and 43 per cent reduction; and the least reduction is shown for the cities, 31 and 35 per cent.

At the age 12 + 13 years, the curves for DMF rates in all five community groups have a marked downward trend after the first or second year. The year in which the minimum level is reached varies; but by 1946 or 1947 the curves are either at the lowest level or very close to it. Except in Trondheim, no definite increase in DMF rates after 1946 is shown for any of the community groups, and in Gjerpen the rates for girls continued to decrease up to 1949. In Trondheim, where the highest DMF rates are found at these ages as at the younger ages, the sharp drop in the curves up to 1946 is followed by a marked rise for both boys and girls. In cities and villages, rates for each sex were nearly identical throughout the study period. In rural districts, the initial rates for boys and girls are similar to those in cities and villages; the reduction is somewhat greater in the rural districts but the difference is more definite for girls than for boys. The curves for boys and girls at Gjerpen are much lower than the other curves for this age group as at the younger ages. In general, they parallel the curves for the rural districts during the first five or six years, but the downward trend continues in Gjerpen to 1948 for boys and to 1949 for girls.

The maximum reduction in the DMF rates for ages 12 + 13 years, expressed as the percentage change from 1940–1941 (Table 23), took place in Gjerpen with 63 and 64 per cent reduction for boys and girls, respectively. The next largest decrease occurred in the rural districts, 40 and 43 per cent; and in the cities and in villages the reduction is nearly equal, 32

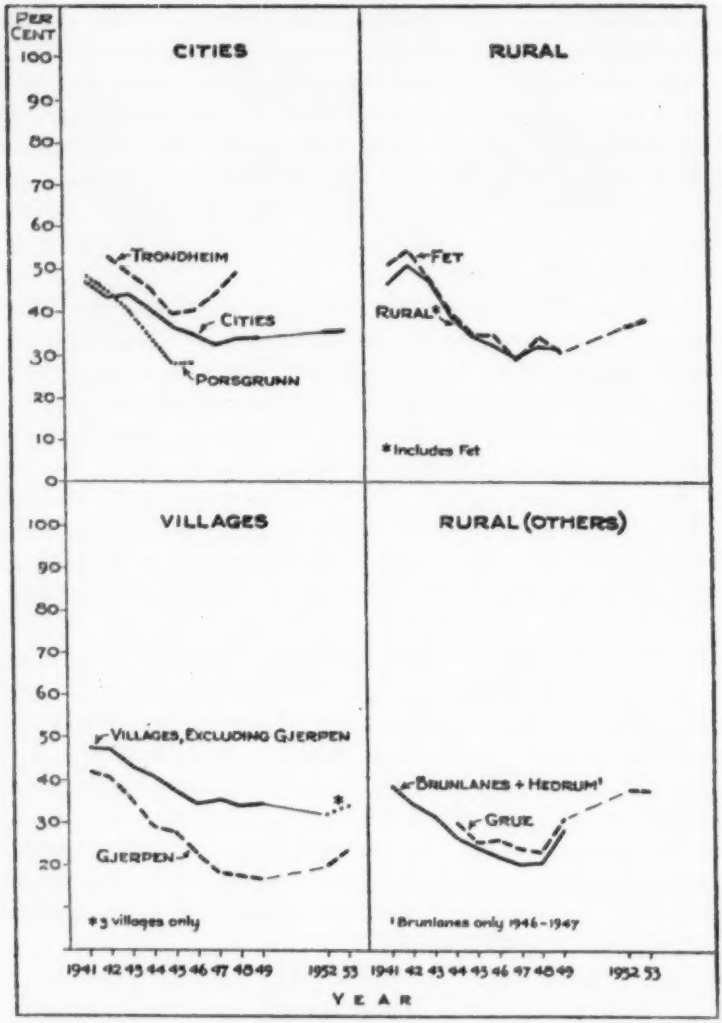


Fig. 33. Percentages of total permanent teeth DMF at age 13 years, combined sexes, in several individual communities and in the community groups.

and 28 per cent for boys and 27 and 31 per cent for girls. Thus, both at younger and older ages, Gjerpen shows the greatest

reduction and rural districts the next. At the younger ages, the reduction in cities was less than in villages but at the older ages, children in cities and villages showed about the same improvement in caries prevalence.

DMF Rates for Upper and Lower Teeth. The percentages of permanent teeth in the upper jaw and in the lower jaw affected by caries have been shown in Fig. 25 which also compares the

Table 27. For 13 year-old children (combined sexes), the percentages of total permanent teeth DMF in each community group, by school-year of examination.

School Year	Cities			Villages		Rural Districts			
	Cities (Main Group)	Trondheim[1]	Porsgrunn[2]	Villages (Main Group)	Gjerpen	Rural (Main Group)	Fet[3]	Brunlanes and Hedrum	Grue[4]
	PER CENT OF TOTAL PERMANENT TEETH DMF								
1940–41	47.6	—	48.2	47.5	42.0	46.5	51.2	39.0	—
1941–42	43.6	52.8	45.0	47.1	40.5	51.2	54.4	34.5	—
1942–43	44.2	49.1	40.0	42.9	35.6	47.1	47.0	31.7	—
1943–44	40.9	45.2	34.4	41.0	29.0	39.7	39.1	26.8	30.9
1944–45	36.7	39.7	28.0	37.5	27.8	34.7	35.0	24.2	25.3
1945–46	35.0	40.5	28.2	34.4	22.4	32.7	34.9	21.8	26.1
1946–47	32.7	44.2	—	35.6	18.2	29.5	29.2	20.4[b]	23.9
1947–48	34.1	49.8	—	34.0	17.6	32.5	34.4	20.8	23.3
1948–49	34.1	—	—	34.9	16.8	31.4	30.8	28.8	31.3
1951–52	35.4[a]	—	—	31.8[a]	19.8	—	37.0	—	38.0
1952–53	35.6[a]	—	—	33.8[a]	23.2	—	38.5	—	37.8
	NUMBER OF ERUPTED PERMANENT TEETH								
1940–41	2,596	—	1,470	4,142	2,202	1,312	650	605	—
1941–42	2,118	3,493	818	3,771	1,908	864	564	701	—
1942–43	2,781	3,978	1,019	4,272	2,088	916	696	920	—
1943–44	4,613	2,209	1,198	4,926	1,722	1,064	470	838	1,293
1944–45	4,696	2,264	763	4,749	1,934	1,247	566	1,099	1,130
1945–46	4,971	2,760	916	5,482	1,543	1,329	825	1,204	1,138
1946–47	3,794	3,612	—	3,042	1,633	1,149	590	323[b]	1,220
1947–48	4,710	1,932	—	3,877	1,443	965	416	510	1,077
1948–49	4,287	—	—	3,842	1,246	831	571	1,140	706
1951–52	4,278	—	—	1,834	1,930	—	584	—	1,219
1952–53	4,059	—	—	2,579	2,104	—	524	—	1,281

[1] No examinations in 1948–1949; 1940–1941 omitted, values of doubtful accuracy.
[2] No examinations after 1945–1946.
[3] Fet included in main rural group.
[4] No examinations in first three years of Study.
[a] Values for "reduced" groups.
[b] Brunlanes only.

DMF rates at ages 7 + 8 years and 12 + 13 years for cities, Trondheim, villages, and Gjerpen for the period 1941 to 1949. The curves for both the upper and lower jaw demonstrate nearly the same relative level for DMF rates in these four communities as the total DMF rates. However, there is a tendency for differences among the communities to be somewhat greater for the upper than for the lower jaw.

DMF Rates for Selected Communities. It was stated previously that not all of the individual communities for which some dental examinations were available could be included in the three main groups (cities, villages, and rural districts). Among the cities, Porsgrunn, in addition to Trondheim, has been dealt with separately because examinations were not continued after 1945–1946 and the trend in DMF rates differed somewhat from that for the main group of cities.

In Fig. 33, and Table 27, the per cent of permanent teeth DMF for 13 year-old boys and girls (combined sexes[8]) in Porsgrunn is compared with rates for the combined cities and Trondheim. For the first two years, the DMF rates for Porsgrunn are nearly the same as rates for cities, but in the following years the rates for Porsgrunn decrease more rapidly. The lowest point of the curve for Porsgrunn is reached in 1945, the same as for Trondheim, whereas the curve for cities reaches its low point in 1947.

Trends in caries rates for the incisors and first permanent molars in 13 year-old children in Porsgrunn are shown in Table 28 and illustrated in Fig. 34. For central and for lateral incisors in the upper and lower jaw, the percentages of teeth affected with caries and the percentages of tooth surfaces affected decrease very sharply from 1941 to 1945. In 1946, rates for central incisors continued downward but for lateral incisors the rates increase. For first molars, however, the percentage of teeth DMF does not show any clearly defined change from 1941 to 1946; but the percentage of tooth surfaces

[8] Although caries rates for boys and for girls of the same age differ, trends during the Study were comparable and the two sexes have been combined in order to eliminate annual variations in rates due to small numbers.

affected with caries does decrease.[9] Percentages of first molars extracted among these 13 year-old children also are shown in Fig. 34 and it is clearly evident that a pronounced decrease in extractions occurred during the period 1941 to 1946.

In the combined rural group,[10] three rural communities—Brunlanes, Hedrum, and Grue—have not been included. In Grue, fairly large numbers of children were examined from 1944 to 1949 and also in 1952 and 1953 and this community, therefore, is studied separately. Brunlanes and Hedrum have been combined, since the dental status of the small groups from each community appeared to be comparable, but are

Table 28. Porsgrunn: Per cent of teeth and of tooth surfaces[1] DMF for the specific permanent incisors and first molars, and the per cent of first molars extracted, for 13 year-old boys and girls combined, 1940–1941 to 1945–1946.

Age and School Year	Number of Children	Central Incisors		Lateral Incisors		First Molars		
		Teeth DMF	Surfaces DMF	Teeth DMF	Surfaces DMF	Teeth DMF	Teeth Extracted	Surfaces DMF
		UPPER JAW						
Age 13 Years								
1940–41	108	70.4	28.9	67.6	26.6	95.4	40.7	48.1
1941–42	60	66.7	24.6	61.7	25.8	96.7	36.7	46.7
1942–43	74	68.9	30.1	64.4	23.6	95.9	29.7	47.6
1943–44	89	55.1	20.8	55.8	19.8	96.6	22.5	45.6
1944–45	56	46.4	16.1	36.4	12.3	96.4	12.5	43.9
1945–46	69	42.0	14.1	43.5	13.8	97.1	7.2	42.3
		LOWER JAW						
1940–41		32.4	11.8	23.1	7.4	97.2	53.7	54.3
1941–42		23.3	8.8	18.3	5.4	96.7	55.0	51.3
1942–43		25.7	9.8	17.6	5.1	95.9	37.8	50.5
1943–44		15.7	5.6	11.2	3.4	96.6	37.1	48.1
1944–45		14.3	4.9	9.1	2.7	98.2	23.2	48.2
1945–46		8.7	3.3	10.3	2.9	94.2	8.7	41.4

[1] Three DMF surfaces per extracted tooth.

[9] Changes in surfaces affected with caries will be discussed in detail for specific teeth and specific surfaces in a later report.

[10] In the combined rural group, the largest representation is from Fet where examinations were done every year 1941 to 1949 and in the second period, 1952 and 1953; a small group from Meldal is included from 1941 to 1949, and a small group from Blaker 1941 to 1946; V. Gausdal is represented by varying numbers of children in 1941 and from 1944 to 1949.

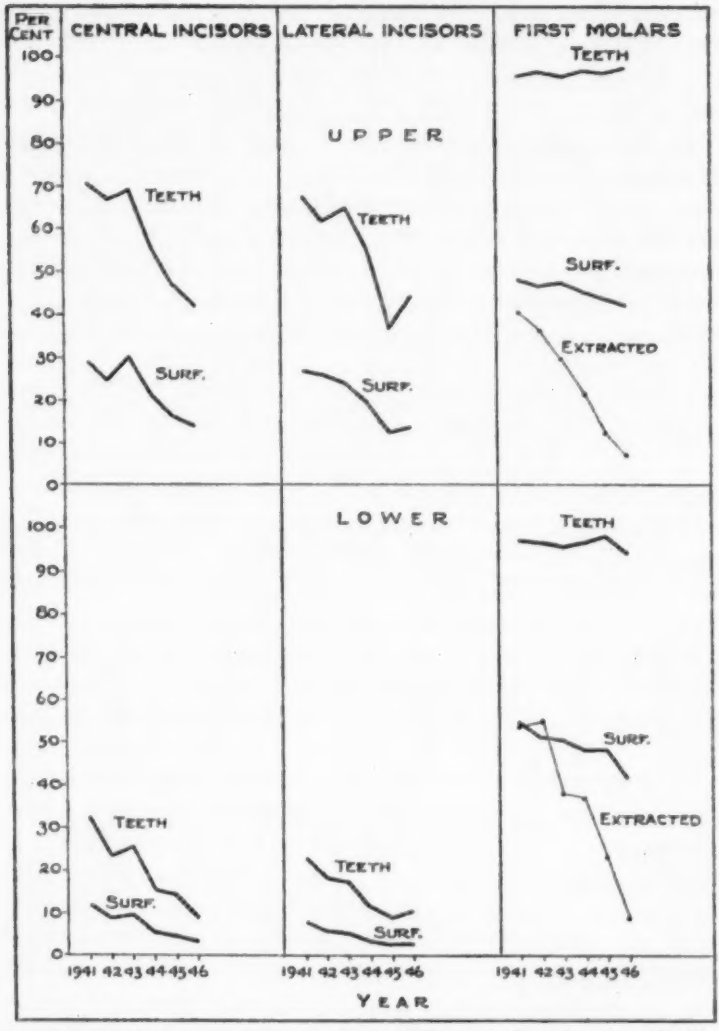


Fig. 34. PORSGRUNN: Per cent of teeth DMF and of tooth surfaces DMF for central and lateral incisors and first molars at age 13 years, combined sexes, 1940–1941 to 1945–1946.

presented independently of the other rural districts because the caries rates are somewhat lower.

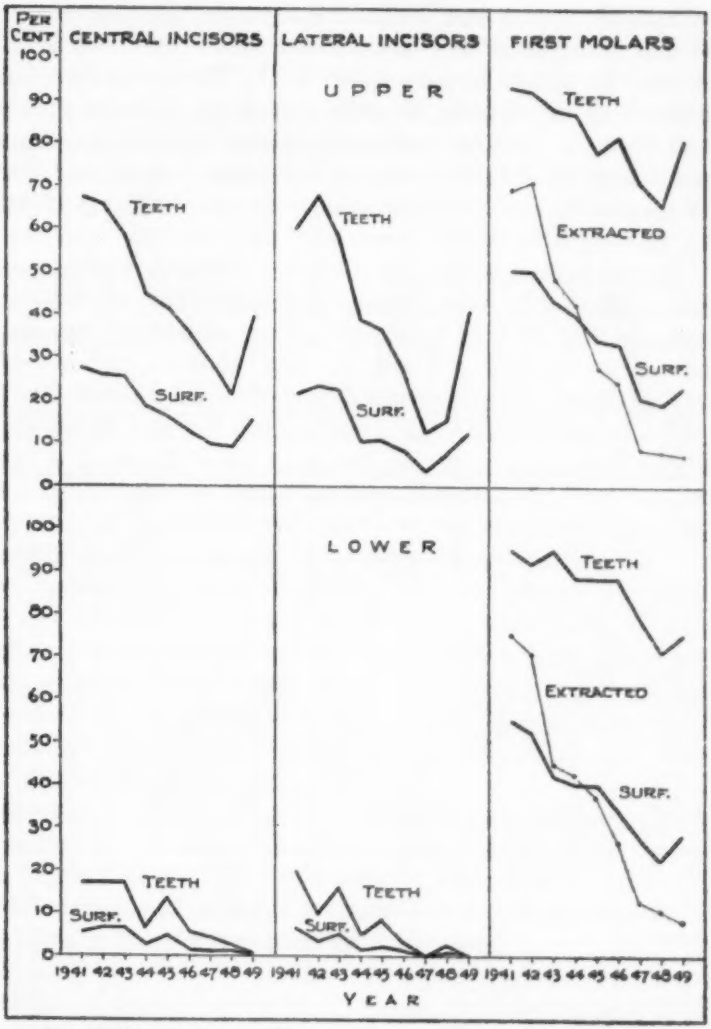


Fig. 35. Brunlanes and Hedrum: Per cent of teeth DMF and of tooth surfaces DMF for central and lateral incisors and first molars at age 13 years, combined sexes, 1940–1941 to 1948–1949.

In Fig. 33 (lower right section) it is seen that the curve for per cent of total teeth DMF at age 13 years, combined

sexes, in Brunlanes and Hedrum follows the usual pattern of decline. The lowest level is reached in 1947 and 1948, and is followed by a definite increase in 1949. The curve for Grue, although slightly higher, is practically identical from 1944 to 1949 with that for Brunlanes and Hedrum. Both of these rural groups have total DMF rates slightly lower than the rates for the combined rural districts, as may be seen in Table 27 and Fig. 33.

Changes in the percentages of incisors and of first permanent molars affected by caries during the period 1941 to 1949 are shown in Fig. 35 and Table 29 for 13 year-old children in

Table 29. Brunlanes and Hedrum: Per cent of teeth and of tooth surfaces[1] DMF for the specific permanent incisors and first molars and the per cent of first molars extracted, for 13 year-old boys and girls combined, 1940–1941 to 1948–1949.

Age and School Year	Number of Children	Central Incisors		Lateral Incisors		First Molars		
		Teeth DMF	Surfaces DMF	Teeth DMF	Surfaces DMF	Teeth DMF	Teeth Extracted	Surfaces DMF
		UPPER JAW						
Age 13 Years								
1940–41	46	67.4	27.7	60.0	21.7	93.5	69.6	50.9
1941–42	52	65.4	26.0	68.0	23.5	92.3	71.2	50.8
1942–43	69	58.0	25.4	58.2	22.8	88.2	48.5	43.2
1943–44	63	44.4	18.7	38.7	10.5	87.3	42.9	40.0
1944–45	82	41.5	16.2	36.6	11.0	78.0	28.0	34.6
1945–46	89	36.0	12.6	27.0	8.4	82.0	24.7	33.5
1946–47	24[a]	29.2	9.4	12.5	3.1	70.8	8.3	20.8
1947–48	38	21.1	9.2	15.8	7.2	65.8	7.9	19.5
1948–49	85	40.0	15.3	40.5	12.2	81.2	7.1	23.5
		LOWER JAW						
1940–41		17.4	6.0	20.0	6.7	95.7	76.1	55.2
1941–42		17.3	6.7	9.6	3.4	92.3	71.2	52.3
1942–43		17.4	6.9	15.9	5.1	95.7	44.9	42.0
1943–44		6.3	2.4	4.8	1.6	88.9	42.9	40.3
1944–45		13.4	4.6	8.5	2.4	89.0	37.8	40.0
1945–46		5.7	1.4	3.4	1.7	88.8	27.0	34.8
1946–47		4.2	1.0	0	0	79.2	12.5	27.5
1947–48		2.6	1.3	2.6	0.7	71.1	0	22.6
1948–49		0	0	0	0	75.3	8.2	28.9

[1] Three DMF surfaces per extracted tooth.
[a] Brunlanes only.

Brunlanes and Hedrum. In level and shape, the curves for the incisors generally adhere to the usual patterns of trends in DMF rates for upper and lower teeth and in rates for tooth surfaces attacked by caries. For the first molars, however, the decrease in DMF rates is much sharper than is usually found, except in Gjerpen. The per cent of first molars extracted was very high at the beginning of the period—70 to 75 per cent—but dropped very rapidly to about 8 per cent at the end of the period.

For Fet, a rural community usually included in the rural group, corresponding rates for incisors and first molars are shown in Fig. 36 and Table 30. For Fet, the curves for the incisors, in the main, follow the same patterns as those in Fig. 35 for Brunlanes and Hedrum, although there are some differences in levels of rates. However, the curves for first molars differ from those for Brunlanes and Hedrum. In Fet, the per cent of first molars DMF does not decrease for these 13 year-old children until the last year, 1949; this is more in conformity with the usual findings. The percentages of tooth surfaces affected by caries in the beginning were about as high in Fet as in Brunlanes and Hedrum, but the decrease is not quite as great. On the other hand, the extraction rate in Fet was much lower initially (31 and 45 per cent for upper and lower first molars, respectively) than in Brunlanes and Hedrum; it decreased almost to zero.

As already mentioned, Fet was included in the rural group for which the percentages of all permanent teeth DMF during the years 1941 to 1949 are shown in Fig. 33 and Table 27. DMF rates for 13 year-old children in Fet are approximately the same as for the combined rural districts.

Conclusion. Children examined in the rural districts demonstrated a greater reduction in caries rates during and after the War than did the city children. The reduction in the village group and in the city group was practically of the same magnitude. In the village of Gjerpen (not included with other villages), the greatest reduction in the prevalence

of carious teeth is shown and the smallest changes in trends are indicated for the final years in the period 1941–1949. In Trondheim, where the initial prevalence of caries was relatively high, the largest reversal of the downward trends is found for the years following the War, and it is the only community in which the 12 + 13 year-old children show an increase in caries rates for the final years of the period 1941–1949.

Table 30. FET: Per cent of teeth and of tooth surfaces[1] DMF for the specific permanent incisors and first molars, and the per cent of first molars extracted, for 13 year-old boys and girls combined, 1940–1941 to 1948–1949 and 1951–1952 and 1952–1953.

Age and School Year	Number of Children	Central Incisors		Lateral Incisors		First Molars		
		Teeth DMF	Surfaces DMF	Teeth DMF	Surfaces DMF	Teeth DMF	Teeth Extracted	Surfaces DMF
		UPPER JAW						
Age 13 Years								
1940–41	49	73.5	28.6	61.2	28.1	98.0	30.6	49.4
1941–42	42	83.3	36.3	63.4	31.1	97.6	26.2	50.5
1942–43	51	66.7	24.0	60.0	24.0	100.0	17.6	44.3
1943–44	35	54.3	21.4	47.1	16.2	100.0	25.7	46.9
1944–45	42	42.9	14.3	45.2	20.2	97.6	7.1	38.1
1945–46	63	46.0	14.7	51.7	18.8	96.8	14.3	40.6
1946–47	45	31.1	10.6	40.9	14.8	97.8	6.7	36.9
1947–48	31	22.6	6.5	30.0	10.0	96.8	6.5	29.0
1948–49	42	28.6	10.7	35.7	10.7	90.5	2.4	28.6
1951–52	44	31.8	11.9	52.3	18.8	100.0	0	39.1
1952–53	40	42.5	12.5	52.5	15.6	100.0	0	42.0
		LOWER JAW						
1940–41		16.3	6.1	18.4	6.6	98.0	44.9	55.5
1941–42		31.0	11.3	21.4	6.0	97.6	38.1	56.2
1942–43		27.5	9.3	17.6	4.4	100.0	35.3	52.5
1943–44		17.1	6.4	11.4	2.9	100.0	31.4	57.7
1944–45		7.1	2.4	4.8	1.8	97.6	19.0	41.9
1945–46		16.1	4.4	9.5	3.2	96.8	20.6	40.6
1946–47		4.4	1.1	2.2	0.6	100.0	8.9	36.0
1947–48		3.2	0.8	3.2	0.8	100.0	16.1	40.6
1948–49		2.4	1.2	2.4	0.6	88.1	0	27.1
1951–52		6.8	2.3	2.3	0.6	97.7	2.3	44.1
1952–53		2.5	0.6	2.5	1.3	90.0	5.0	47.0

[1] Three DMF surfaces per extracted tooth.

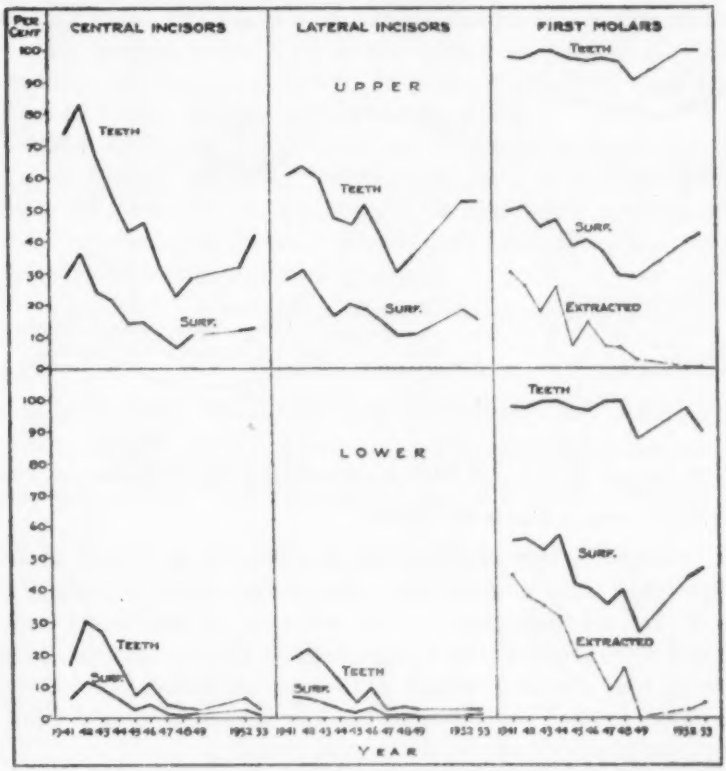


Fig. 36. FET: Per cent of teeth DMF and of tooth surfaces DMF for central and lateral incisors and first molars at age 13 years, combined sexes. 1940–1941 to 1948–1949, and 1951–1952 and 1952–1953.

CARIES RATES FOR THE PERMANENT DENTITION IN 1951–1952 AND 1952–1953 COMPARED WITH THOSE FOR 1940–1941 TO 1948–1949

In the second period of the investigation, 1951–1952 and 1952–1953, it was not possible to obtain examinations for the school population in a number of communities included in the first period. Consequently, the child population of the main community groups—cities, villages, and rural districts—in the second period was not comparable with that for the first period.

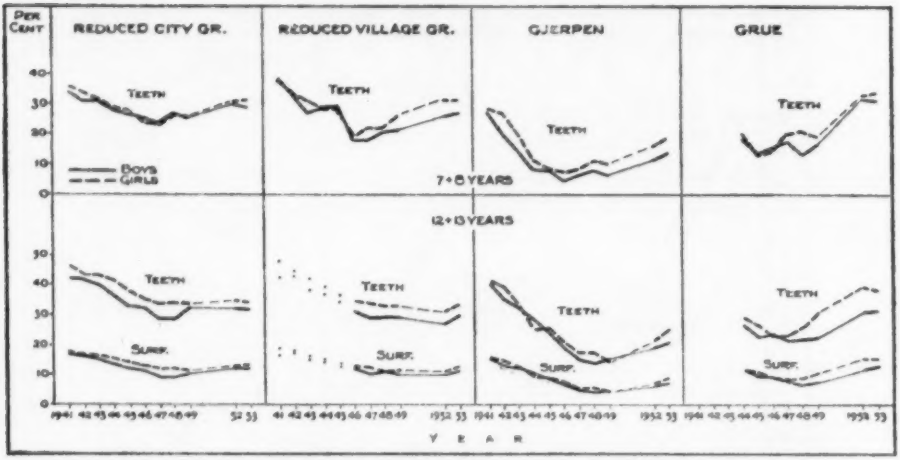


Fig. 37. Per cent of total teeth DMF in 1951–1952 and 1952–1953 compared with first period, 1940–1941 to 1948–1949 for ages 7 + 8 years and 12 + 13 years in reduced city and reduced village groups, in Gjerpen and in Grue.

A "reduced" group of cities and of villages was formed to include only those communities with examinations in both periods[11] and for these groups, rates in the second period are compared with those in the earlier period. Of the original rural group, only Fet is available in the second period. Two communities studied separately in the first period, Grue and Gjerpen, are available also in the second period.

DMF Rates for Total Teeth at Ages 7 + 8 Years. For both periods of the Study, the annual percentages of total teeth DMF are shown in Fig. 37 and Table 31 for boys and girls aged 7 + 8 years in the reduced city group, the reduced village group, Gjerpen, and Grue. The rise in the curve for each sex-age group in each of the four communities that began in the years 1946–1949 continued and values for the later period, 1952 and 1953, are much higher than those at the end of the first period. The increase seems to be greatest in Grue, where, unfortunately, values prior to 1943–1944 are not available and it is not possible to determine whether the rates had reached the level that

[11] The reduced group of cities is the same as the main group except that Tromsö is omitted; the reduced village group includes only Oppegård, Baerum, and Stord.

existed at the beginning of the War. In the other three community groups, caries rates in the second period had not yet reached the initial high levels. In this respect, there does not seem to be any difference between the sexes.

DMF Rates for Total Teeth and Surfaces at Ages 12+13 Years. For the age group 12 + 13 years, the annual DMF rates for total teeth and the percentages of total tooth surfaces affected by caries are shown in Fig. 37 and Table 32 for boys and girls in the four community groups.[12]

Table 31. For 7+8-year-old boys and girls, per cent of total permanent teeth DMF in reduced cities, reduced villages, Gjerpen, and Grue, 1940–1941 to 1948–1949 and 1951–1952 and 1952–1953.

School Year	Boys				Girls			
	Reduced Cities	Reduced Villages	Gjerpen	Grue[1]	Reduced Cities	Reduced Villages	Gjerpen	Grue[1]
	PER CENT OF TEETH DMF							
1940–41	34.7	37.9	27.7	—	36.3	37.6	28.5	—
1941–42	31.1	32.4	20.3	—	33.8	32.9	26.9	—
1942–43	30.9	26.9	15.3	—	31.7	31.0	19.9	—
1943–44	27.9	28.4	8.5	18.4	28.7	28.7	11.6	19.8
1944–45	26.5	28.8	7.8	14.2	27.4	28.6	8.7	13.1
1945–46	24.8	18.2	4.6	15.4	23.8	18.8	7.4	14.3
1946–47	23.9	17.9	6.4	17.4	24.2	21.8	8.5	19.9
1947–48	27.2	20.7	7.8	13.5	26.4	22.2	11.1	21.1
1948–49	25.2	21.0	6.4	17.3	25.4	26.3	10.0	19.7
1951–52	29.8	26.3	11.7	31.9	30.3	30.9	16.0	33.3
1952–53	28.7	27.2	14.3	31.4	30.8	30.9	19.2	34.0
	NUMBER OF ERUPTED PERMANENT TEETH							
1940–41	1,088	704	506	—	1,172	892	519	—
1941–42	1,324	993	582	—	1,421	1,192	476	—
1942–43	1,324	1,058	570	—	1,431	1,157	478	—
1943–44	1,274	880	505	375	1,231	985	439	384
1944–45	1,237	495	489	367	1,188	626	520	350
1945–46	1,357	875	566	351	1,137	1,008	632	335
1946–47	1,420	968	652	321	1,280	1,023	718	468
1947–48	1,447	1,042	625	230	1,605	1,111	659	350
1948–49	1,403	943	596	191	1,578	1,172	643	249
1951–52	1,694	966	770	505	1,750	1,038	882	460
1952–53	1,863	1,449	1,003	513	1,846	1,335	1,055	568

[1] No examinations prior to 1943–1944.

[12] Rates for a comparable group of villages could not be computed for the entire

(Continued on page 187)

Table 32. For 12+13 year-old boys and girls, per cent of total permanent teeth DMF and per cent of total surfaces[1] DMF in reduced cities, reduced villages, Gjerpen, and Grue, 1940–1941 to 1948–1949 and 1951–1952 and 1952–1953.

School Year	Boys				Girls			
	Reduced Cities	Reduced[2] Villages	Gjerpen	Grue[3]	Reduced Cities	Reduced[2] Villages	Gjerpen	Grue[3]
	PER CENT OF TEETH DMF							
1940–41	42.3	—	39.6	—	46.4	—	40.2	—
1941–42	41.4	—	34.7	—	43.2	—	39.0	—
1942–43	40.2	—	32.4	—	43.3	—	33.5	—
1943–44	36.2	—	28.8	27.3	40.8	—	24.9	29.1
1944–45	32.4	—	25.2	22.8	37.4	—	26.0	26.6
1945–46	31.8	30.8	18.7	24.2	35.3	34.4	21.7	23.2
1946–47	28.5	29.1	15.8	21.6	33.5	34.3	18.4	23.7
1947–48	28.7	29.6	14.6	21.8	34.1	33.0	18.3	26.1
1948–49	32.1	29.2	15.3	22.7	33.5	32.9	14.6	31.0
1951–52	32.1	27.1	18.9	30.9	34.4	31.2	21.6	39.5
1952–53	31.4	30.2	21.2	31.5	33.8	33.4	25.7	38.1
	PER CENT OF TOTAL SURFACES DMF							
1940–41	17.1	—	15.1	—	18.1	—	15.6	—
1941–42	16.2	—	13.1	—	16.7	—	14.6	—
1942–43	15.4	—	12.5	—	16.5	—	12.9	—
1943–44	13.8	—	10.6	11.1	15.6	—	9.2	11.2
1944–45	12.2	—	9.1	9.3	14.2	—	9.6	10.7
1945–46	11.5	11.7	6.4	9.2	13.0	13.0	7.8	9.1
1946–47	9.3	10.3	4.9	7.6	12.0	12.4	5.6	8.3
1947–48	9.4	10.8	4.5	6.8	12.2	11.1	5.8	9.1
1948–49	10.6	10.0	4.7	7.7	11.2	11.3	4.7	10.7
1951–52	12.5	10.0	6.3	11.8	13.3	11.1	7.2	15.4
1952–53	12.6	11.3	7.3	12.9	13.8	12.6	8.9	15.3
	NUMBER OF ERUPTED PERMANENT TEETH							
1940–41	2,697	—	1,871	—	2,411	—	2,063	—
1941–42	2,158	—	1,782	—	2,356	—	1,987	—
1942–43	2,485	—	1,699	—	2,083	—	1,959	—
1943–44	3,197	—	1,690	1,074	3,412	—	1,763	1,319
1944–45	3,367	—	1,640	1,099	3,480	—	1,781	1,084
1945–46	2,955	2,545	1,581	1,220	3,138	2,457	1,464	1,126
1946–47	3,086	2,143	1,641	1,132	3,020	2,097	1,427	1,151
1947–48	3,117	2,425	1,653	1,071	3,305	2,400	1,182	984
1948–49	3,013	2,356	1,343	564	2,765	2,346	1,200	730
1951–52	3,624	1,970	2,207	996	3,885	1,890	1,949	1,473
1952–53	3,342	2,272	2,115	1,004	3,962	2,434	1,777	1,289

[1] Three carious surfaces counted for each extracted tooth.
[2] Data not comparable in 1940–1941 to 1944–1945.
[3] No examinations prior to 1943–1944.

The lowest part of each curve for the percentages of teeth DMF and also for the percentages of tooth surfaces DMF is usually found in 1947 or 1948. Except for Grue, rates for girls aged 12 + 13 years do not show any increase up to 1949. For boys, in the cities there is a tendency for the DMF rates for teeth and for tooth surfaces to rise at the end of the first period; in Gjerpen, only DMF rates for teeth show this tendency.

In the second period, in Gjerpen and Grue the percentages of teeth DMF and of surfaces DMF have increased considerably over the 1949 rates; and for the reduced village group, these rates show a tendency to rise in 1953 above the 1949 rates. For the reduced city group, the rates for carious surfaces but not for DMF teeth are higher in the second period than at the end of the first period.

At ages 12 + 13 years, the increase in DMF rates from the end of the first period to the second is greatest in Grue, as it was at ages 7 + 8 years. Only in Grue are the rates for 12 + 13 year-old boys and girls higher in the second period than in 1943–1944.

DMF Rates for Permanent First Molars. Caries rates for first molars in the upper and lower jaws in 1952 and 1953 are compared with rates in the earlier period in Fig. 38 and in Table 33 for 7 + 8 year-old boys and girls. In each of the four community groups, reduced cities and villages, Gjerpen and Grue, the increase from the low levels recorded in 1946 or 1947 to 1949 has continued. It is apparent in Fig. 38 that the percentages of teeth DMF and the percentages of tooth surfaces caries affected have risen from the end of the first period to the second period. For the first molars, as for total teeth, the increase in caries is greatest for children in Grue, and it is very probable that in this community rates in 1953 had reached the levels that prevailed at the beginning of the War.

first period and for the second period, since in one village included in the second period, Stord, 12 and 13 year old children were examined only from 1945–1946 to 1948–1949 in the first period. Therefore, the original village group has been used for the years 1940–1941 to 1944–1945, and comparison of the second period for reduced villages with early years of the first period may not be very reliable.

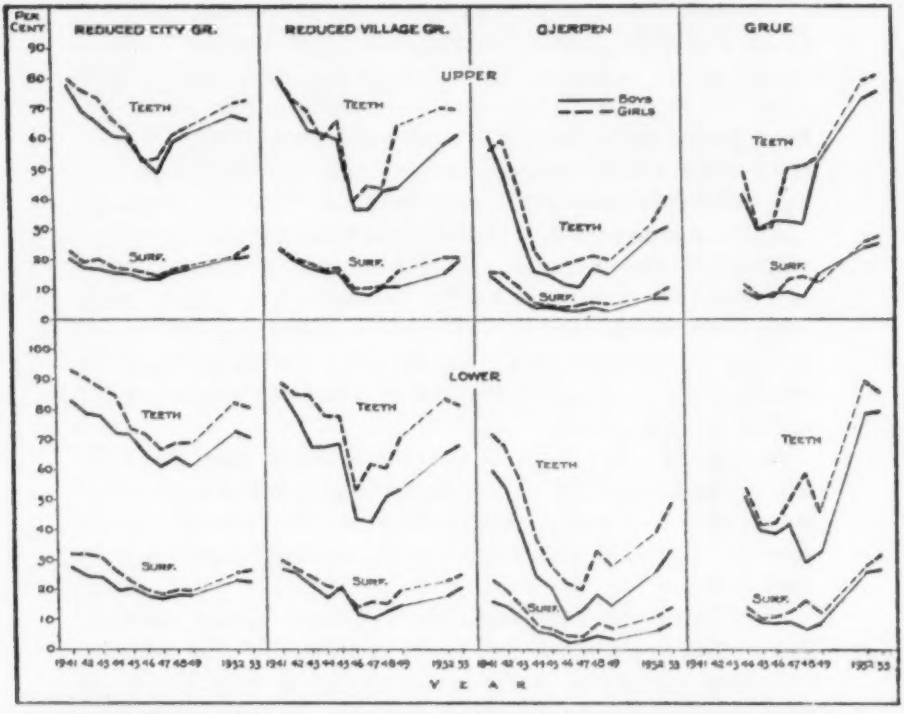


Fig. 38. Per cent of permanent first molars DMF and per cent of tooth surfaces DMF at ages 7 + 8 years in 1951–1952 and 1952–1953 compared with first period, 1940–1941 to 1948–1949, in reduced city and reduced village groups, in Gjerpen and in Grue.

Comparison of the relative increase in the percentages of first molars affected by caries and the percentages of tooth surfaces carious indicates that for boys and girls aged 7 + 8 years the increase has been greater for surfaces affected than for teeth affected in every community. Expressed in another way, the general picture is that the average number of carious surfaces per affected tooth was higher in 1952 and 1953 than in the later years of the first period.

The DMF rates for first molars at these younger ages increased more than the DMF rates for total permanent teeth as may be seen by comparing Fig. 37 and Fig. 38.

Table 33. For 7+8 year-old boys and girls, per cent of teeth and of surfaces DMF for the permanent first molars in the reduced cities, reduced villages, Gjerpen and Grue, 1940–1941 to 1948–1949, and 1951–1952 and 1952–1953.

School Year	Number of Boys	Boys				Number of Girls	Girls			
		Upper First Molars		Lower First Molars			Upper First Molars		Lower First Molars	
		Per Cent DMF					Per Cent DMF			
		Teeth	Surf.	Teeth	Surf.		Teeth	Surf.	Teeth	Surf.
		REDUCED CITIES								
1940–41	227	77.9	20.7	83.6	27.1	211	80.3	23.3	93.3	31.9
1941–42	262	69.1	17.4	79.2	24.5	261	76.2	19.3	90.3	32.3
1942–43	268	65.5	17.3	78.0	24.2	256	74.1	19.9	87.1	31.2
1943–44	257	61.0	15.6	72.6	20.2	230	66.4	17.3	85.1	26.0
1944–45	253	60.6	15.4	72.1	20.4	237	62.2	16.4	73.8	22.4
1945–46	293	53.1	13.4	65.3	18.1	215	52.4	15.4	72.3	20.3
1946–47	307	48.6	13.6	61.6	17.0	250	53.6	14.1	66.8	18.5
1947–48	310	58.8	16.3	64.5	18.0	303	61.0	17.0	69.0	19.9
1948–49	290	62.2	17.0	61.6	17.8	291	64.2	18.2	69.1	19.7
1951–52	344	68.1	20.5	73.2	22.9	326	72.2	21.1	82.6	26.2
1952–53	376	66.4	20.9	70.8	22.4	335	73.2	24.6	80.4	26.6
		REDUCED VILLAGES								
1940–41	158	81.1	23.9	86.8	26.9	176	81.2	24.2	89.0	29.9
1941–42	203	71.7	20.1	78.7	25.4	225	73.1	20.2	85.5	26.9
1942–43	209	62.9	17.6	68.0	20.9	214	69.6	19.0	85.3	24.5
1943–44	191	62.0	16.2	67.8	17.6	191	60.2	16.7	77.8	20.8
1944–45	108	59.8	15.9	68.9	21.2	126	66.7	17.5	77.9	20.2
1945–46	190	37.1	9.1	43.6	11.8	199	39.7	10.3	53.6	13.9
1946–47	212	36.8	8.5	42.4	10.6	202	44.4	10.4	62.1	16.2
1947–48	228	43.3	10.8	51.4	13.1	229	43.7	11.3	60.5	15.3
1948–49	205	44.2	11.3	53.8	15.2	222	64.4	17.2	71.7	20.0
1951–52	205	58.1	15.6	66.2	18.0	198	70.4	20.8	83.4	22.9
1952–53	297	61.5	19.9	68.5	21.3	249	69.7	21.1	81.3	25.3
		GJERPEN								
1940–41	103	61.2	15.1	60.0	16.2	95	56.2	15.7	72.0	23.2
1941–42	114	48.1	11.3	54.1	14.4	87	59.5	15.7	68.2	20.0
1942–43	117	30.2	7.6	39.3	10.4	89	44.7	11.3	55.7	14.1
1943–44	100	16.5	4.1	24.2	6.1	85	22.8	4.8	36.9	8.3
1944–45	104	14.9	3.8	20.6	5.3	100	16.8	3.8	27.6	6.9
1945–46	120	11.8	3.2	10.0	2.3	121	17.9	3.9	21.8	4.5
1946–47	141	10.9	2.9	12.9	3.0	137	20.1	5.2	19.9	4.4
1947–48	131	17.5	3.8	18.4	4.5	122	21.6	5.9	32.8	8.9
1948–49	121	15.4	3.1	14.4	3.4	120	19.8	5.0	28.3	7.2
1951–52	167	29.2	7.7	25.9	6.4	169	32.5	8.1	38.9	11.1
1952–53	210	31.4	7.6	33.7	9.0	196	41.7	11.1	49.2	14.6
		GRUE[1]								
1943–44	72	42.0	10.1	51.4	12.5	69	49.3	11.9	54.4	14.4
1944–45	71	30.0	7.7	40.0	9.7	60	30.0	8.3	41.7	10.7
1945–46	69	33.3	9.0	39.1	9.0	61	31.7	8.3	42.6	11.1
1946–47	65	33.3	9.5	42.2	9.7	89	50.6	13.8	51.1	13.2
1947–48	53	32.0	8.0	29.4	7.1	66	50.8	15.1	59.1	16.7
1948–49	39	52.6	15.8	33.3	9.2	48	54.3	13.0	45.8	12.1
1951–52	99	74.2	24.7	79.2	26.3	81	80.0	26.3	90.1	28.1
1952–53	98	76.8	26.1	80.0	27.2	102	82.2	28.7	86.0	32.2

[1] No examinations prior to 1943–1944.

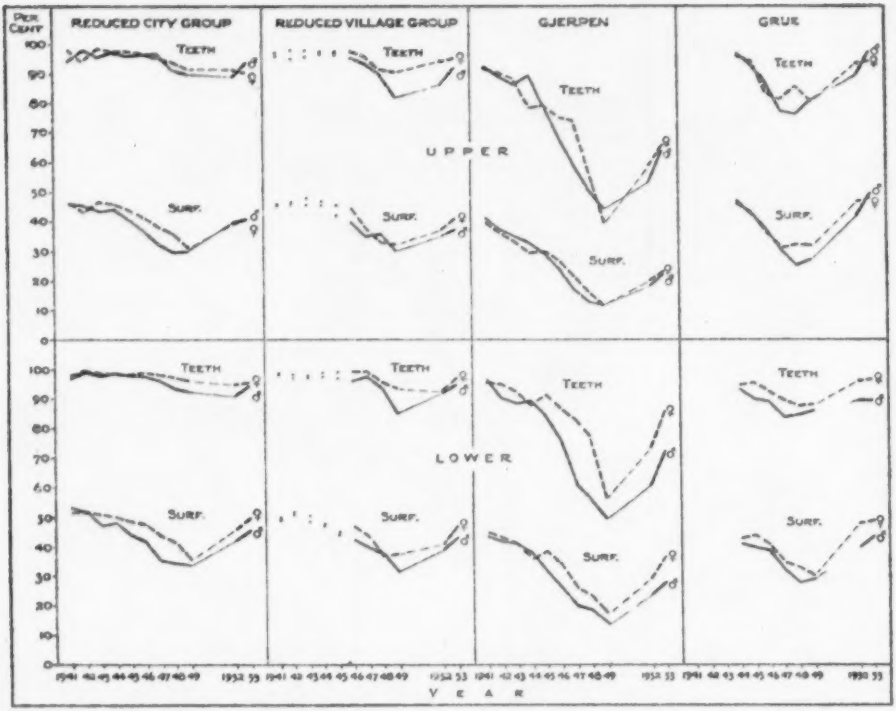


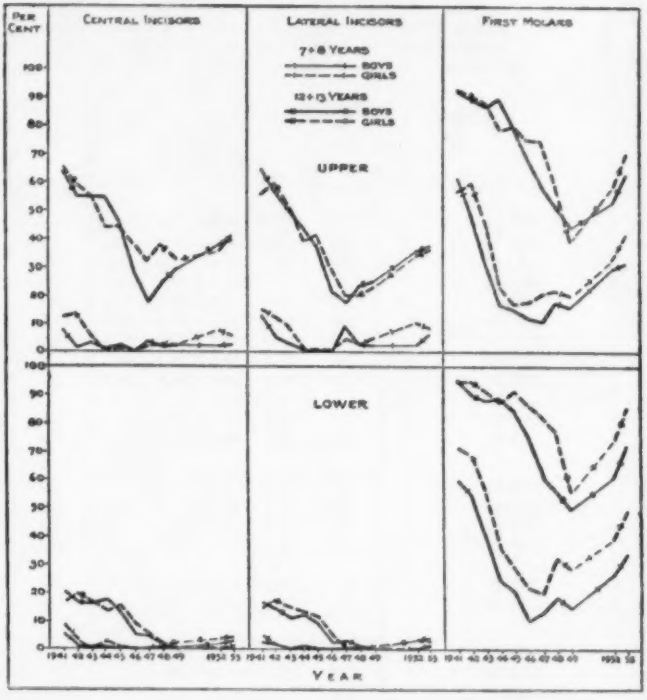
Fig. 39. Per cent of permanent first molars DMF and per cent of tooth surfaces DMF at ages 12 + 13 years in 1951–1952 and 1952–1953 compared with first period, 1940–1941 to 1948–1949, in reduced city and reduced village groups, in Gjerpen and in Grue.

For the age group 12 + 13 years, the percentages of first permanent molars DMF were at the lowest level in 1948 or 1949 for all community groups, as is shown in Fig. 39 and Table 34. These four community groups differed greatly in the reduction in DMF rates for the first molars during the first period, the reduction being least in cities and most in Gjerpen where the decrease in rates also started earlier. In the second period, 1952 and 1953, the percentages of first molars DMF showed an increase over the 1949 rates in villages, in Gjerpen, and in Grue. In the cities, there was little change, but the rates for upper and lower molars of boys showed a tendency to rise in 1953.

Table 34. Per cent of teeth and of surfaces DMF for the permanent first molars of 12+13 year-old boys and girls in the reduced cities, reduced villages, Gjerpen and Grue—1940–1941 to 1948–1949, and 1951–1952 and 1952–1953.

School Year	Boys					Girls				
	Number of Boys	Upper First Molars		Lower First Molars		Number of Girls	Upper First Molars		Lower First Molars	
		Per Cent DMF					Per Cent DMF			
		Teeth	Surf.	Teeth	Surf.		Teeth	Surf.	Teeth	Surf.
					REDUCED CITIES					
1940–41	206	94.7	45.8	97.1	53.0	180	97.8	45.6	97.8	51.3
1941–42	168	98.2	45.0	98.8	51.3	176	93.8	42.7	98.9	51.7
1942–43	194	95.4	43.0	97.4	47.2	156	98.7	46.4	98.7	51.0
1943–44	250	97.6	43.8	99.2	48.1	256	97.3	45.6	98.4	50.0
1944–45	269	96.3	40.4	97.4	43.9	264	97.7	43.5	97.7	48.6
1945–46	234	96.6	36.7	97.4	41.9	237	97.0	41.3	98.7	47.4
1946–47	249	96.4	31.7	96.0	35.0	230	94.8	37.8	98.3	43.7
1947–48	245	91.4	29.6	93.1	34.1	250	94.0	35.8	96.8	41.3
1948–49	237	89.8	29.7	91.9	33.6	212	91.5	30.1	96.2	35.7
1951–52	287	89.2	39.6	90.6	41.9	294	91.5	39.3	94.6	45.8
1952–53	271	94.1	40.5	94.1	45.1	298	90.3	40.4	95.3	49.8
					REDUCED VILLAGES[1]					
1945–46	205	95.6	39.3	96.1	42.1	189	97.4	44.8	98.9	46.9
1946–47	171	93.6	34.7	97.7	39.9	162	95.7	37.3	98.8	43.8
1947–48	196	89.8	35.8	93.4	37.4	185	90.8	32.2	95.1	37.0
1948–49	196	82.1	29.4	84.7	31.9	183	90.7	31.9	92.9	37.5
1951–52	160	86.3	34.4	91.9	38.6	147	93.9	36.6	91.8	40.8
1952–53	183	91.8	37.0	94.5	43.0	189	95.2	40.3	96.8	46.6
					GJERPEN					
1940–41	146	91.8	41.1	95.9	43.2	157	92.4	39.6	94.9	44.2
1941–42	138	89.1	37.0	89.9	41.7	151	90.1	35.4	94.7	42.9
1942–43	135	86.7	34.7	88.1	40.6	148	87.8	32.8	91.9	40.7
1943–44	135	89.6	32.6	88.9	37.2	132	78.0	28.8	87.1	35.8
1944–45	131	79.4	29.0	84.0	31.0	135	79.3	29.2	91.1	38.2
1945–46	130	68.5	23.4	75.4	25.2	112	75.0	26.1	86.6	33.8
1946–47	133	57.9	16.2	60.9	19.2	109	74.3	20.9	82.6	25.9
1947–48	132	50.0	12.6	56.1	18.0	94	57.4	15.5	76.6	23.0
1948–49	109	44.0	11.4	49.5	13.8	95	38.9	11.6	55.8	17.1
1951–52	180	52.8	17.3	60.6	23.2	149	58.4	19.3	73.2	29.3
1952–53	173	64.2	22.0	72.3	28.0	138	71.0	22.9	85.5	36.5
					GRUE[2]					
1943–44	86	96.5	46.7	93.0	40.9	98	95.9	45.3	93.9	42.2
1944–45	86	93.0	41.6	89.5	39.3	82	93.9	42.9	95.1	43.4
1945–46	97	87.6	36.7	88.7	38.4	86	83.7	35.1	91.9	40.5
1946–47	92	77.2	29.6	83.7	31.7	90	81.1	30.4	88.9	34.0
1947–48	88	76.1	24.8	84.1	27.3	77	85.7	31.7	87.0	32.7
1948–49	48	81.3	26.7	85.4	28.8	56	80.4	31.1	87.5	29.6
1951–52	82	89.0	41.2	89.0	40.0	114	92.9	46.2	95.6	47.4
1952–53	83	97.6	49.6	89.2	43.4	99	93.9	47.5	96.0	48.5

[1] Reduced village data not comparable for ages 12+13 years in 1940–1941 to 1944–1945.
[2] No examinations prior to 1943–1944.



In Gjerpen the DMF rates in 1953 had increased almost to the levels in 1946, and in Grue the rates had reached the 1944 level, the earliest year of record for this community.

The percentages of surfaces of permanent first molars affected by caries for 12 + 13 year-old boys and girls declined more in all four community groups than the percentages of teeth DMF, and were at the lowest level in 1948 or 1949. In the later period, rates for surfaces affected had increased greatly over the 1949 rates.

Gjerpen, DMF Rates for Specific Teeth. In Fig. 40, caries rates for each specific tooth for boys and girls in Gjerpen are shown for the two periods of study.

The large increase in DMF rates for first molars at ages 7 + 8 years from the end of the first period to the second period has been discussed. There were small increases in DMF rates for the upper lateral incisors for both sexes and for the upper central incisors in girls only. At this age, the lower incisors have such low caries rates that significant changes would be hard to demonstrate.

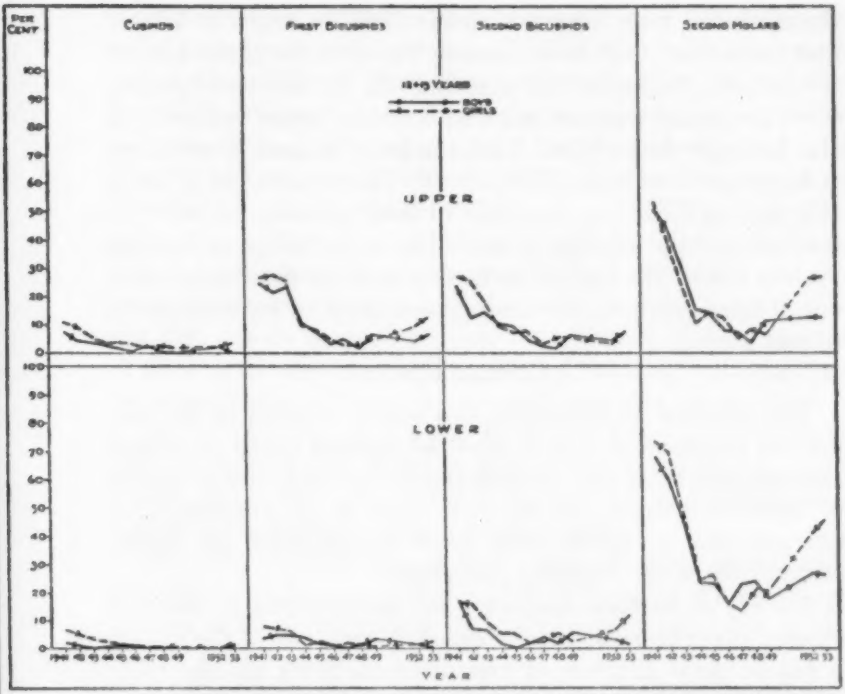


Fig. 40. GJERPEN: Per cent of specific teeth DMF at ages 7+8 years and 12+13 years in 1951–1952 and 1952–1953 compared with first period, 1940–1941 to 1948–1949.

At ages 12+13 years, the DMF rates in Gjerpen are much higher in 1953 than in 1949 for upper and lower incisors, and for upper and lower molars. For the cuspids and bicuspids, annual rates are somewhat irregular but a tendency to increase may be seen in rates for the upper first bicuspids in both sexes and the lower second bicuspids in girls. For none of the teeth have the caries rates in 1953 reached the levels for 1941.

DMF Rates in Fet at Age 13 Years. Prevalence of caries in 1952 and 1953 in Fet, a rural community, is shown in Fig. 36 and Table 30 for children 13 years of age, both sexes. As previously discussed, during the first period there was a rapid downward trend in DMF rates for incisors and first molars and

the minimum rates were recorded in 1949 for upper and lower first molars and both lower incisors but rates for upper incisors were slightly higher in 1949 than in 1948. In the second period, there is a sharp increase in caries rates for upper incisors and also for upper first molars. Caries in lower incisors do not seem to have increased from 1949 to 1953. The percentages of lower first molars DMF are irregular in both periods, but the per cent of surfaces affected is much higher in the second period than in 1949. The rate of extraction of lower first molars, but not of upper molars, also shows a tendency to increase in the second period.

Conclusion

The principal findings from this study of caries in the permanent dentition of 7 to 13 year-old children based on annual examinations from 1941 to 1949 and in 1952 and 1953 in groups of cities, of villages, and of rural districts, in Trondheim, in Gjerpen and in several other small communities, are briefly summarized in the following paragraphs.

A study of bilateral symmetry for examinations in one year showed that the occurrence of caries in each side of the mouth is nearly equal in terms of prevalence rates for specific teeth affected by caries.

The percentages of children aged 7 + 8 years who had no caries in the permanent dentition increased three to four times from 1941 to 1946. After 1946, the percentages decreased to 1949 but remained above the initial levels.

The average number of DMF teeth per child and also the percentage of total teeth DMF showed a definite decrease in 1942, or in 1943, in almost every instance. In the younger age group (7 + 8 years), the minimum values usually were reached in 1946, whereas in the older age group (12 + 13 years) the lowest values occurred one to three years later. The percentage reduction in DMF rates was greater at the younger than at the older ages; and varied for different community groups from 31 to 83 per cent at the younger ages and from 27 to 64 per cent at older ages.

The reduction in the per cent of specific teeth DMF showed great variation from tooth to tooth. The teeth with the lowest caries susceptibility—the incisors, the first bicuspid, and the cuspid in the lower jaw—demonstrated the greatest reduction in caries rates. In the age group 12 + 13 years the drop was close to 100 per cent for several teeth. The smallest reduction was found for the first molars of 12 + 13 year old children. The percentage reductions in caries rates for the upper incisors in this age group were about the same for both the lateral and the central and were also of nearly the same magnitude as that for the first molars in the 7 + 8 year old children. Within groups of teeth of the same morphological type, the tooth with the lowest susceptibility showed the greatest reduction relatively.

The trend of the curves for the percentage of total surfaces DMF was generally similar to that for the percentage of teeth DMF. Here, too, an inverse correlation between caries susceptibility and caries reduction was found.

The rate of extraction of first molars dropped in all communities, and in most of them from a level, in the older age groups, of 40–45 per cent in 1941 to a point close to zero at the end of the first period, 1949.

A comparison of the various community groups showed that the greatest reduction in caries took place in the village community Gjerpen (not included in the main village group). Next in order came the rural group. The village group and the city group were about equal.

In all groups the per cent of total teeth DMF, the per cent of total surfaces DMF, the per cent of specific teeth DMF, and the per cent of surfaces DMF in specific teeth increased during the second period of study, 1951–1952 and 1952–1953. Except for a few instances, the latest values did not, however, reach the levels of the initial rates.

The girls generally showed higher caries rates than boys. The maximum reductions in caries rates for girls and boys did not show any constant differences which might point to an actual sex differential in changes in caries status in response to the

nutritional and environmental conditions operating during the period of study.

A more general discussion of the changes in the dental status in relation to the diet during the war and post-war years will be given in the next section of this report.

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AN ESTIMATE OF THE EXPECTATION OF LIFE IN THE UNITED STATES IN 1850

PAUL H. JACOBSON[1]

LIFE tables for the United States, based on the mortality experienced in the country as a whole, are available only since 1929–1931. Official tables are also available for the Original Death Registration States since 1900–1902 and for the Death Registration States of 1920 since that year, but these relate only to the designated geographic areas of the country.

For the second half of the 19th Century, the existent life tables are even more restricted—being limited largely to Massachusetts (1a). Since the latter tables are available for a number of time periods starting with 1850, they have often been used to trace the course of the expectation of life in the United States during the past century. However, the 1850 life table for Massachusetts (2) is deficient for general use in that only values of ${}_nm_x$ and selected values of $\mathring{e}_x$ have been published. Moreover, since Massachusetts was one of the most urbanized States in the country, the mortality from infectious diseases may have been higher there than in most other areas. In consequence, the expectation of life was probably lower in Massachusetts than in the country as a whole. Indicative of this is the fact that in 1900–1902, the earliest period with reasonably comparable data, the expectation of life at birth for white males in Massachusetts was about two years less than that in the Original Death Registration States (1b). Fortunately, 1850 mortality data are also available for Maryland (2), and these data averaged with those for Massachusetts appear to approximate the experience in the United States as a whole. For males, the resulting estimate of the expectation of life at birth in the United States exceeds that for Massachusetts by the same amount as in 1900–1902; for females, the differential in 1850 is 0.8 years greater than in the recent period.

[1] Supervising Statistical Analyst, Metropolitan Life Insurance Co.

Data and Method. The values of ${}_nm_x$ for the white population in the United States were derived by taking the arithmetic average of the values for Maryland and Massachusetts. A short-cut method was then used to proceed from ${}_nm_x$ to ${}_nq_x$ at each age interval (3), and the values of q_x at single ages were then interpolated. In view of the imperfect nature of the basic data, the latter was accomplished by distributing the values of ${}_nd_x$ according to the values of d_x in other tables for approximately the same time period.

The Life Table for 1850. The approximated life table for white males and females in 1850 is summarized in Table 1. Several aspects are worthy of mention. First, with the ex-

Table 1. Approximate life table, white population by sex, United States, 1850.[1]

Age (x)	Mortality Rate ($1{,}000q_x$)		Number of Survivors (l_x)		Expectation of Life in Years ($\mathring{e}_x$)	
	Male	Female	Male	Female	Male	Female
0	160.6	130.8	100,000	100,000	40.4	43.0
1	63.5	59.6	83,936	86,921	47.1	48.4
2	35.5	33.8	78,606	81,738	49.2	50.4
3	23.3	22.9	75,817	78,974	50.0	51.2
4	17.5	16.7	74,052	77,164	50.2	51.4
5	15.7	12.9	72,755	75,878	50.1	51.2
10	5.3	5.9	68,836	72,464	47.8	48.6
15	4.4	6.6	67,253	70,356	43.9	44.9
20	9.1	9.6	65,299	67,613	40.1	41.7
25	9.5	10.9	62,317	64,247	36.9	38.7
30	10.5	11.5	59,359	60,798	33.6	35.8
35	11.3	12.8	56,226	57,274	30.4	32.8
40	14.7	12.7	53,008	53,613	27.1	29.9
45	17.2	12.7	49,006	50,323	24.1	26.7
50	20.4	13.9	44,628	47,079	21.2	23.3
55	22.9	16.9	40,055	43,701	18.3	19.9
60	25.6	22.4	35,498	39,701	15.3	16.7
65	35.1	31.9	30,625	34,901	12.4	13.6
70	55.3	44.3	24,924	28,833	9.6	10.9
75	81.2	67.3	17,829	22,085	7.4	8.5
80	115.4	96.5	10,770	14,555	5.7	6.6
85	164.4	138.7	5,236	8,063	4.2	5.0

[1] Based on mortality experience in Maryland and Massachusetts.

tremely high mortality rate in infancy, only about five-sixths of the white male babies survived to their first birthday. In contrast, five-sixths of the babies currently born in the United States may expect to live beyond age 53. The 1850 record for females was not much better than that for the males. For both sexes, mortality was so high at the early ages that the expectation of life increased to a peak at age 4 and remained above the expectation of life at birth until the late teen-ages.

From age 10 through most of the childbearing period, females experienced a higher mortality rate than men. As a result, the expectation of life at age 10 for women exceeded that for men by less than one year. Moreover, their proportion surviving from birth to age 40 was about the same as for the men.

After mid-life, as in the first decade of life, white females experienced lower mortality rates than males. Nevertheless, at no period of life did the women enjoy an advantage in longevity of as much as three years. Currently, by contrast, their advantage over men amounts to as much as six years in early life and does not fall below three years until old age (4).

Comparison with Other 19th Century Tables for the United States. In 1850, the expectation of life at birth in the United States, computed on the basis described, was 40.4 years for white males and 43.0 years for the females; at age 5, the respective figures were 50.1 and 51.2 years. Two other tables for approximately the same period show fairly comparable figures. For example, data gathered by Jaffe and Lourie (5) from several sources indicate that the expectation of life at age 5 was 52.4 years for white persons in the United States in 1830. A table by Meech (6), based only on population statistics from the United States census enumerations for 1830 to 1860, showed the expectation of life at birth as 41.0 years for white males and 42.9 years for white females; at age 5, the respective figures were 51.1 and 51.6 years.

Comparison with Foreign Countries. Conditions in the United States were apparently not unlike those which prevailed in much of Western Europe. This is evident from Table 2,

which shows the expectation of life at selected ages for the United States and for several European nations at periods around 1850. Thus, the expectation of life at birth in the United States was about the same as in Denmark and Scotland, but averaged about one and a half years less than in Sweden and four and a half years less than in Norway. On the other hand, the record for the United States was more favorable than that for England, France, The Netherlands, and Iceland.

Several of the characteristics already noted for the United States are also evident for the other countries. For example, the expectation of life was greater at age 5 than at birth. However, the table also makes evident one new feature; in areas with poor longevity records the expectation of life was higher at age 20 than at birth, and the more so the lower the figure at birth. It is noteworthy that this pattern is still found today in countries with relatively unfavorable health conditions (7).

Comment. Considering the poor state of sanitary conditions and the other health hazards of generations ago, it is remarkable that mortality rates were not higher than they were. A century ago, there was still little or no provision for safeguarding food and water supplies or for disposal of refuse or other

Table 2. Expectation of life in years for males and females at specified ages, selected countries, around 1850.

Country[1] and Period	Male				Female			
	At Birth	Age 5	Age 20	Age 40	At Birth	Age 5	Age 20	Age 40
Norway (1846–55)	44.9	52.4	42.0	28.0	47.9	55.0	44.5	29.7
Sweden (1841–55)	41.3	49.4	38.6	24.3	45.6	53.0	42.1	27.2
Denmark (1840–49)	40.9	50.8	40.1	25.8	43.5	51.6	41.8	27.8
United States (1850)[2]	40.4	50.1	40.1	27.1	43.0	51.2	41.7	29.9
Scotland (1861–70)	40.3	48.9	38.8	*	43.9	51.0	41.1	*
England and Wales (1838–54)	39.9	49.7	39.5	26.1	41.9	50.3	40.3	27.3
France (1861–65)	39.1	51.8	41.2	27.3	40.6	51.8	41.6	28.2
Netherlands (1850–59)	36.4	48.3	38.0	24.7	38.2	48.9	38.9	26.1
Iceland (1850–60)	31.9	45.9	36.4	24.1	37.9	52.6	43.5	29.2

* Not available.
[1] Ranked according to the expectation of life at birth for males.
[2] White population only, from Table 1.

waste products. Moreover, there were no controls against the infectious diseases, with the result that epidemics of smallpox, yellow fever, cholera, typhoid fever and other contagions recurred at intervals and took a heavy toll of life. The records for a number of our cities (8) and states (9) provide ample evidence of the high level of mortality, and the marked annual fluctuations, during the 19th Century.

Under the circumstances, most persons born around 1850 encountered during their lifetime much the same health and mortality conditions that prevailed at the time of their birth. In consequence, the actual average lifetime for a cohort of persons born a century ago did not differ to any considerable extent from their expectation of life at birth. In fact, the indications are that they lived only about one year longer, on an average, than that expected when they were born.

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7. *See for example* the experience for Egypt during 1936–1938 and for India during 1941–1950, in Demographic Yearbook, 1955. New York, United Nations, 1955, Table 32, pp. 740–743.

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ARE SEX MORTALITY DIFFERENTIALS BIOLOGICALLY CAUSED?[1]

FRANCIS C. MADIGAN, S.J.[2]

SEVERAL previous studies by demographers have drawn attention to the continuous divergence of male and female expectations of life in this country since 1900. Wiehl in 1938 pointed out the widening gap between the sexes, suggested the need for research into the causes, and called for medical specialization in care for men just as gynecologists have specialized in care of women.[3] Yerushalmy in a sex and age investigation of our population composition showed the striking increases which had occurred in the percentage of women among the older people of our country during the period from the census of 1920 to that of 1940.[4] More recently, Bowerman has produced new data which prove that the gap has continued to widen rather than to narrow.[5]

In 1900, the white women of this country enjoyed but a 2.85 year advantage over comparable males in expectation of life at birth. By 1950, this female advantage had doubled to 5.8

[1] This project was financed by a grant from the National Institutes of Health for which help the writer is duly grateful. He is deeply indebted to Dr. Rupert B. Vance of the University of North Carolina who directed the dissertation upon which this paper reports. He also wishes to express gratitude to Dr. Daniel O. Price and Dr. Bernard G. Greenberg of the same University for assistance in the statistical analysis, as well as to Dr. Mortimer G. Spiegelman of the Metropolitan Life Insurance Company for valuable advice. Finally, he wishes to acknowledge his irreparable debt to the religious Communities who cooperated in this study, both by joining him in the collection of data and by making their files accessible to him: The Brothers of Christian Instruction, Alfred, Me.; The Franciscan Brothers of Cincinnati, O.; The Sisters of St. Joseph, Philadelphia, Pa.; The Sisters of the Holy Child, Rosemont, Pa.; The Ursuline Nuns of Cleveland, O.; The Ursuline Nuns of the Union, Eastern Province; and the many other Communities who wished to remain anonymous.

[2] From the University of North Carolina.

[3] Wiehl, Dorothy G.: Sex Differences in Mortality in the United States. Milbank Memorial Fund *Quarterly*, April, 1938, XVI, pp. 145–55.

[4] Yerushalmy, Jacob: The Age-Sex Composition of the Population Resulting from Natality and Mortality Conditions. Milbank Memorial Fund *Quarterly*, January, 1943, XXI, pp. 37–63.

[5] Bowerman, Walter G.: Annuity Mortality. *Actuarial Society of America: Transactions*, 1950, II, Part 2, pp. 76–102.

years, and the national abridged tables for 1954 show a difference of 6.2 years.

Why have men not profited from the better conditions of this century to the same extent as women? What are the chances that their days of life can be prolonged to equal those of the female sex?

Such questions raise further ones. Are these differentials in rates of dying chiefly reflections of the greater sociocultural pressures and strains which our culture lays upon male shoulders? Or are the differentials rather to be associated mainly with biological factors related to sex? If the former is the case, then probably little can be done to enable men to enjoy a life as long as women's. Short of a profound cultural revolution in our society, it appears that men must continue to experience greater stresses. However, if sex-linked biological factors principally underlie the differentials, the prognosis is more hopeful. It seems likely in this case that medical research can isolate the factors responsible for greater female viability, and use this knowledge to advantage in the treatment of middle-aged and old men, assuming of course that this can be done without disturbing psychological balance or causing observable physical reactions.

A quickening of interest in the problem of the diverging death trends of our men and women has occurred during the past few years and has resulted in a rather large amount of journal literature upon the question. However, most of this has been descriptive and speculative rather than analytic and research-oriented. The present article reports upon the results of a study which has attempted to shed some light upon the problem through the tools of demographic research.

Research Design

There seems to be no question that the differentials between the sexes in perinatal and infant mortality are due to biological rather than to sociocultural factors.[6] Accordingly, this study

[6] The most pertinent and forceful of the many studies showing the existence

(Continued on page 204)

is concerned only with that part of the life from age fifteen onwards.

The design chosen was that of the "ex post facto experiment." Thus the problem was one of finding a male group and a female group in which cultural stresses and strains had been so standardized between sexes that one could observe the operation of biological factors in comparative isolation.

The subjects chosen for study were teachers and personnel of administrative staffs of Roman Catholic religious Brotherhoods and Sisterhoods engaged in educational work. Communities of these which operated hospitals were eliminated from the universe, and in communities actually studied the life records of Brothers and Sisters devoting their energies to household and manual duties were discarded as were those of infirmarians and nurses (who are in charge not of extern patients but of sick members).

Also eliminated from consideration were the records of those who had served in foreign missions, those who had been married before entrance into religious life, the foreign-born, the nonwhite, and those who had entered into the religious community on or after their twenty-seventh birthday. The reason for all these eliminations was the imposition of controls that would yield as homogeneous a group of subjects as possible.

While in the general public single men are more given to dissipation than single women, a life of dissipation is equally out of the question for both sexes in religious communities. Moreover, Brothers are not subject to military service after their entrance into religious life. Further, the daily regime of Brothers and Sisters is extremely similar as regards time for sleep, work, study, and recreation, and with respect to diet, housing, and medical care. (However, the life of the young Sisters seems to be slightly more stressful.)

It must be admitted that the Brothers are more likely to smoke and to take an occasional drink. Only recently have Sis-

of these differentials is that of Sam Shapiro: The Influence of Weight, Sex, and Plurality on Neonatal Loss in the United States. *American Journal of Public Health and the Nation's Health*, 1954, XLIV, pp. 1142–1153.

ters been permitted to smoke and only in a limited number of communities. An important factor that is not controlled because of the absence of relevant data is the relative incidence of obesity or of overeating within each sex group. However, it may be observed that Sisters do not have the same motives for slimness found among their sex in the general public.

Such control of sociocultural factors, it was assumed, would permit the desired operation of biological factors working in comparative isolation. Five highly significant sources of differential stress between the sexes had been eliminated: (1) male service in the armed forces; (2) greater male liberty to dissipate; (3) the dissimilar roles of husband and wife; (4) male employment in hazardous and life-shortening occupations; and (5) the employment of men and women in diverse occupations. Other sources of differential sociocultural stress also appear to have been eliminated or greatly curtailed. Maternal mortality, of course, had also been excluded by the very nature of the female group under observation.[7]

Health requirements suitable for the teaching occupation were demanded of candidates for entrance into the religious life by both Brothers and Sisters during the entire period of observation. Such screening was based upon personal knowledge of the candidate's past health, his or her condition at time of entrance, and the person's health record during the one or more years of trial before the first vows are pronounced. It appears that Sisters required a medical examination by a physician earlier and more widely than the Brothers. This requirement seems to have become the common practice by about 1930.

Since stable death rates were desired, a large number of

[7] A detailed discussion of the research design will be found in a previous article by Rupert B. Vance and Francis C. Madigan, S.J.: Differential Mortality and the "Style of Life" of Men and Women: Research Design. TRENDS AND DIFFERENTIALS IN MORTALITY. 1955 Annual Conference of the Milbank Memorial Fund. New York, Milbank Memorial Fund, 1956, pp. 150–163. A later and more comprehensive treatment is also available in the writer's unpublished doctoral dissertation available in the University of North Carolina Library: The Differential Mortality of the Sexes, 1900–1954: Cultural and Biological Factors in the Diverging Life Chances of American Men and Women. University of North Carolina, Chapel Hill, 1956.

years of exposure to risk of dying was needed. Because the number of religious persons, especially of Brothers, was limited, the person-year of life was chosen as the unit of study, and the period of observation was extended from January 1, 1900 to December 31, 1954.

Sampling lists of all teaching communities of Brothers and Sisters in the United States were prepared from various editions of THE OFFICIAL CATHOLIC DIRECTORY.[8] A sample of twenty-two Brothers' communities and of fifty-three Sisters' communities was drawn by probability sampling from these lists. In terms of members living in 1927, which we treated as the mid-year of the study, the sample of Brothers comprised 100 per cent of the Brothers' universe, while that of the Sisters included 59.3 per cent of the Sisters' universe. The response from these communities was good with twenty communities of Brothers cooperating, representing more than 98 per cent of the Brothers' membership as measured in terms of 1927, and with forty-one communities of Sisters cooperating, representing 83.9 per cent of the membership in the Sisters' sample as measured, again, in terms of 1927.

In each of these communities life records were collected for the full membership of Brothers and Sisters since January 1, 1900, with the exception of persons who had not persevered for some part of three calendar years in the community. (The person-years in religious life of these latter were estimated on a sample basis.) All deaths were recorded, even if such death had occurred within the calendar year of entrance. When eliminations had been made according to the "experimental" controls described above, this left 9,813 life records of Brothers and 32,041 for Sisters.

In studying the literature, it had appeared to us that the greater weight of expert opinion lay on the side favoring biological factors as the principal causes for the sex differentials in the death rates. Accordingly, the research hypotheses were

[8] THE OFFICIAL CATHOLIC DIRECTORY. Milwaukee, Wiltzius and Company, 1900–1911. New York, Kenedy and Son, 1912–1955.

framed from this point of view and were expressed as follows:

> 1. Given two groups of American adults, one all male, the other all female, both drawn from the universe of healthy, native white persons in the United States who have reached age fifteen: if both groups are subjected to closely similar sociocultural stresses and strains over a long period of time, the female group will continue to show significantly more favorable death rates than the males.
>
> 2. The mortality differentials between the two experimental groups will not differ significantly from the patterns exhibited by the national population, or else will show increased female superiority.

While these hypotheses assume for testing purposes that biological factors linked with sex chiefly underlie women's pervasive advantage in length of life, and that the differing amounts of sociocultural stress borne by men and women have little relation to this female advantage, neither hypothesis should be misinterpreted to mean that social strains and pressures are believed to be unimportant in the chain of events which leads to an individual's death. In fact, evidence is strong that social strains may play a leading role in the deaths of both sexes. Rather, proper interpretation of these hypotheses understands them to mean that, other things being equal, the same objective stresses and strains upon equal numbers of men and women will lead to the deaths of more men than women during a given period of time.

Methodology

From the life records of these Sisters and Brothers age-specific death rates by ten year age groups were worked out for each decade, 1900–1950, and for the five years, 1950–1954, as well as for the entire period, 1900–1954. Ratios were formed by dividing the death rates of Brothers by those of American native white males, and the rates of Sisters by the corresponding females. Life tables were developed by the Reed-Merrell method for the same age groups and periods.[9]

[9] Quality checks were designed to keep error from all sources under control at two per cent or less. This error will be further reduced in forthcoming studies.

Theoretical Model

On the assumption that the Brothers and Sisters studied constitute a group in which sociocultural stresses have been very greatly standardized between sexes, what results would indicate that such sociocultural factors are chiefly responsible for the differentials in mortality trends of American men and women? On the other hand, what results would point to biological factors as being the chief agents?

If the death rates of the Brothers should prove to have been lower than those of males of the general public, while Sisters exhibited death rates approximately equivalent to those of Brothers, the sociocultural hypothesis would be confirmed. For this would show that the variation in death rates of each sex is closely associated with variations in the amount of sociocultural stresses undergone.

On the other hand, this null hypothesis would be rejected and the biological hypothesis strengthened if the differences between the death rates of Brothers and Sisters should remain rather similar to the differentials found between death rates of men and women of the general public.

However, two points need emphasis here. The first concerns the Brothers. No matter which hypothesis is actually closer to the truth, Brothers should have experienced death rates somewhat lower than those of white males of the general public, at least at ages under forty-five. First of all, they presumably suffer accident rates—especially motor vehicle accident rates—far below those of white males of the same age. Secondly, they would not have been exposed to the disabilities often resulting from military service (except Brothers who had been in service before entrance, none of whom would have been admitted to religious life if they had shown serious disability). Thirdly, their occupation, teaching, seems to be less stressful and dangerous than that of the average white male outside religious life. Finally, they have not carried on their shoulders the worries of a husband or a father about the security of his family.

The second point relates to the Sisters. Young Sisters at least (those up to about age 40) lead a life which appears more stressful than that of the average female in the general public. They teach long hours, and work on college and graduate degrees during their spare time. Most of them do not have a summer vacation but rather attend classes, teach catechism, take parish censuses, or participate in other activities.

Accordingly, even if sociocultural factors should be only of slight importance in relation to the observed sex mortality differentials of the general public, one would still not anticipate finding that young Sisters, at least, had experienced greater gains over females of the general public in mortality rates than Brothers had made over the corresponding males. Thus if Sisters have experienced significantly lower death rates than Brothers, and if at the same time the gains they made over females of the general public were not much smaller than those made by Brothers over the males, this would constitute strong evidence for rejecting the second null hypothesis. This hypothesis states that although biological factors may prove more important than sociocultural stresses, nevertheless sociocultural stresses still will be found to play an important part in the total effect of differential sex mortality.

Findings

Results confirm both research hypotheses and indicate (1) that biological factors are *more* important than sociocultural pressures and strains in relation to the differential sex death rates; and (2) that the greater sociocultural stresses associated with the male role in our society play only a small and unimportant part in producing the differentials between male and female death rates.

Analysis of Results by Expectation of Life[10]

In general, life expectations of Brothers at all ages but the

[10] The abridged life tables from which these expectations were drawn will be found in the writer's dissertation: The Differential Mortality of the Sexes, pp. 225–252. The fractions upon which the death rates were based will also be found in this place.

oldest (where the frequencies were very small) proved to be considerably greater than those of white males of the general public.[11] Such a result was to have been anticipated under either biological or sociocultural hypotheses.

The important point, however, is that Sisters' expectations of life did not in general recede from the favored position of white females. Rather, they too usually made gains over these females. Table 1 shows that in thirty-eight cases Sisters had greater expectations of life than these white females, whereas the latter had greater expectations in only four cases.

Moreover, in these culturally standardized groups, Sisters' and Brothers' expectations of life did not tend to vary about the same means, but Sisters consistently exhibited greater expectations of life, and Brothers shorter expectations. Only seven times in the abridged life tables did Brothers enjoy longer expectations of life, while Sisters were favored in this manner thirty-three times. It is noteworthy that most of the Brothers' advantage came at ages 15–34 when they would be favored by accident rates, and in the years 1900–1919 when young Sisters appear to have had extremely high rates of tuberculosis.[12]

Comprehension of these results is aided by studying expectation of life at age 15, which summarizes results for the entire period of religious life from entrance until death; and expectation of life at age 45, which summarizes the experience for middle and old age only. This latter expectation is particularly important, in fact is crucial in this research design, be-

[11] When comparing Brothers' expectations with those of males of the general public, one must bear in mind that a small part of the Brothers' advantage is a statistical artifact. In the first four decades, for the age group 85 years and above, the central death rate used for the life tables of both Brothers and Sisters was the United States native white rate as common to both sexes. This device was employed because of the paucity of Brothers at these ages, and because of the desire to hold constant death rates of Brothers and Sisters at previous ages, while still finishing off the tables. A similar procedure was used in the first two decades for ages 75–84. Stable Brothers' rates—if they had been obtainable—would probably have been nearer those of native white males than the rates for both sexes taken together. On the other hand, Sisters' expectations were somewhat deflated, since in general at these ages the actual rates of Sisters were more favorable than the native white rates not specific for sex.

[12] *See* footnotes 14–19.

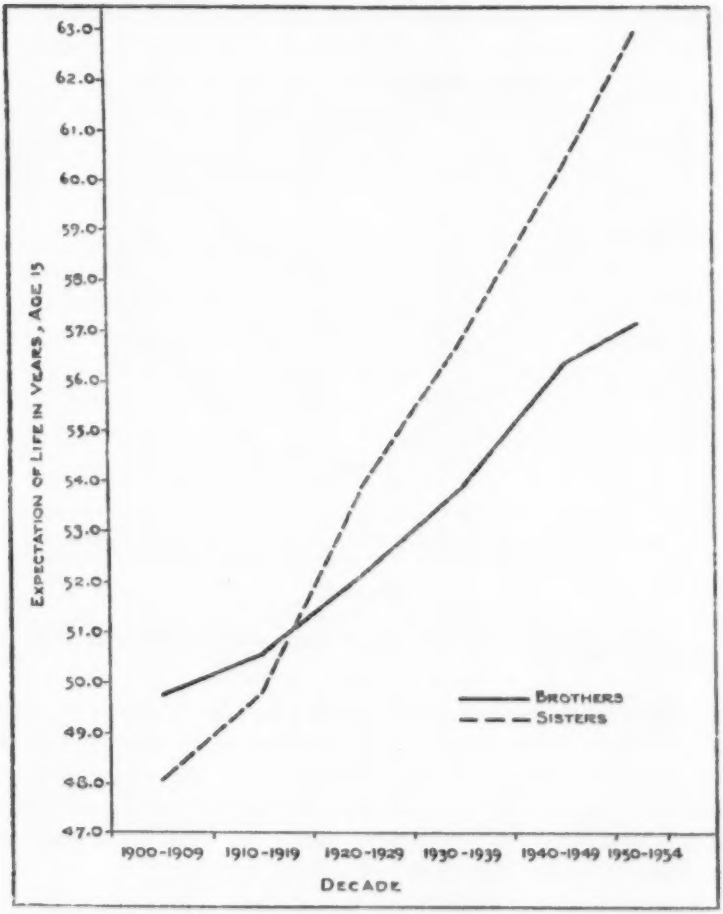

Fig. 1. Expectations of life in years at age 15, Brothers and Sisters, 1900–1954. *See* Table 1.

cause if social pressures were the main reason for the differentials in death rates of men and women in our general public, then at ages 45 and above in these standardized groups Brothers' and Sisters' death rates should show great convergence. For in the general public it is during the years from 45 to 65 that men seem to undergo greatest social strains and pressures.

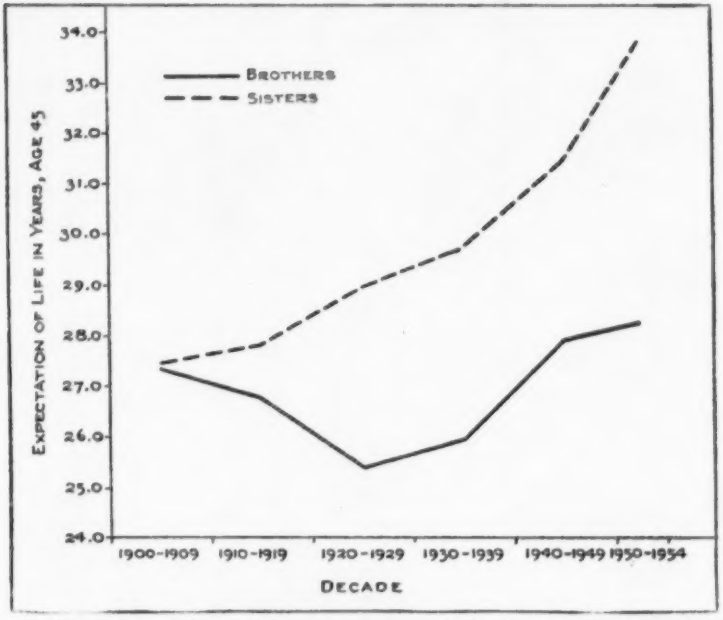

Fig. 2. Expectations of life in years at age 45, Brothers and Sisters, 1900–1954. *See* Table 1.

Accordingly, one would expect such pressures to exert an ever greater cumulative weight and to exact an increasing toll in the years following age 45. Therefore, on the hypothesis of sociocultural causation, standardization of such pressures ought to result in Brothers' and Sisters' death rates which vary about the same averages for each age group.

Figures 1 and 2 (which are based upon Table 1) make it abundantly clear that such convergence has not occurred at the middle and older ages, and they also show that even at age 15 the expectations have favored Sisters without exception from the third decade onwards. A comparison of the two figures also makes it evident that the Brothers' chief period of advantage was between ages 15 and 44.

The trends over time are important, too, for the consistency of the trend lines at age 15 minimizes the probability that Sis-

Table 1. Expectations of life in years at specified ages, Brothers and Sisters, and white males and females of the United States death registration states, with ratios of female to male expectancies, 1900–1954.

Group	Ages							Period
	15	25	35	45	55	65	75	
E.G.M.[1]	49.72	41.98	35.13	27.35	21.96	14.97	7.18	1900–09[2]
E.G.F.	48.03	41.25	34.96	27.45	19.69	12.74	7.18	
Ratio	.97	.98	1.00	1.00	.90	.85	1.00	
U.S.M.	46.58	38.66	31.18	24.04	17.22	11.38	6.80	1900–11
U.S.F.	48.46	40.46	32.96	25.48	18.30	12.10	7.26	
Ratio	1.04	1.05	1.06	1.06	1.06	1.06	1.07	
E.G.M.	50.58	42.67	35.25	26.76	19.99	12.26	7.27	1910–19[2]
E.G.F.	49.80	42.46	35.65	27.81	20.15	12.69	7.27	
Ratio	.98	1.00	1.01	1.04	1.01	1.04	1.00	
U.S.M.	48.32	40.20	32.41	24.93	17.81	11.73	7.02	1909–21
U.S.F.	49.90	41.72	33.98	26.22	18.79	12.36	7.41	
Ratio	1.03	1.04	1.05	1.05	1.06	1.05	1.06	
E.G.M.	52.13	43.41	34.58	25.42	17.09	10.40	5.92	1920–29[2]
E.G.F.	53.83	45.11	37.01	28.97	20.75	13.55	8.32	
Ratio	1.03	1.04	1.07	1.14	1.21	1.30	1.41	
U.S.M.	50.06	41.69	33.54	25.64	18.28	11.99	7.16	1919–31
U.S.F.	51.84	43.40	35.30	27.18	19.50	12.78	7.59	
Ratio	1.04	1.04	1.05	1.06	1.07	1.07	1.06	
E.G.M.	53.85	44.17	34.58	25.96	18.52	12.20	6.83	1930–39
E.G.F.	56.78	47.31	38.32	29.74	21.65	14.28	8.48	
Ratio	1.05	1.07	1.11	1.15	1.17	1.17	1.24	
U.S.M.	51.36	42.53	33.84	25.58	18.16	11.92	7.10	1929–41
U.S.F.	54.54	45.52	36.72	28.14	20.16	13.18	7.74	
Ratio	1.06	1.07	1.09	1.10	1.11	1.11	1.09	
E.G.M.	56.32	46.60	36.99	27.95	19.80	13.24	7.81	1940–49
E.G.F.	60.18	50.39	40.77	31.47	22.81	14.74	8.71	
Ratio	1.07	1.08	1.10	1.13	1.15	1.11	1.12	
U.S.M.	53.26	44.10	35.02	26.37	18.72	12.41	7.47	1939–51
U.S.F.	57.73	48.28	38.99	30.01	21.66	14.28	8.40	
Ratio	1.08	1.09	1.11	1.14	1.16	1.15	1.12	
E.G.M.	57.14	47.37	37.61	28.27	20.21	12.85	7.75	1950–54
E.G.F.	62.97	52.97	43.25	33.83	24.87	16.55	9.62	
Ratio	1.10	1.12	1.15	1.20	1.23	1.29	1.24	
U.S.M.	54.4	45.2	35.9	27.1	19.3	13.0	8.0	1952
U.S.F.	59.9	50.3	40.8	31.6	23.0	15.3	9.1	
Ratio	1.10	1.11	1.14	1.17	1.19	1.18	1.14	

[1] E.G.M. and E.G.F. refer, respectively, to the Brothers and Sisters studied; U.S.M. and U.S.F. refer, respectively, to the white male and female populations of the expanding registration states. Decade expectations for the registration states' population were found by averaging the two values given for the triennium at each census date beginning and ending a decade, except the rates for 1952 which are the rates for this year.

[2] Because of the paucity of native Brothers at ages 75 and above in the decade 1900–1909, at ages above 85 in the 1910–1919, 1920–1929, and 1930–1939 decades, life tables for both Brothers and Sisters for these decades were finished off by using for both sexes the age-specific death rates of the United States native white population, as unsplit for sex. Interpolation between decades gave the decade value. This device permitted the finishing of the tables while keeping constant any differences Brothers and Sisters had manifested at younger ages.

Sources: For United States rates, 1900–1951: United States National Office of Vital Statistics: United States Life Tables, 1949–1951, Vital Statistics, Special Reports, Vol. xli, 1954, p. 30.

For United States rates, 1952: United States National Office of Vital Statistics, Vital Statistics of the United States, 1952, Vol. I. Washington, United States Government Printing Office, 1955, Table II, p. xxvi.

For Brothers and Sisters: Francis C. Madigan, S.J.: The Differential Mortality of the Sexes, 1900–1954. (Unpublished Doctoral Dissertation, University of North Carolina, Chapel Hill, 1956), pp. 118–120 and pp. 225–252. This source gives the abridged tables as well as the central death rates on which they were based.

ters' advantages after 1919 are due to chance factors, while the consistent upward secular trend of Sisters at age 45 and the fluctuation of Brothers' expectations around a mean of about 27.5 years of remaining life, appears even more cogent.

Are these differences between Brothers' and Sisters' expectations of life statistically significant? If so, the null hypothesis that sociocultural factors are the chief reasons for the differentials between male and female death rates may be rejected.

In order to make this test, the data for the entire period of observation were pooled. Since the proportional age and decade distributions of Sisters resembled those of Brothers very closely, it was not necessary to weight Sisters' decade death rates to those of Brothers. However, the rates of United States native white males and females were weighted to those of Brothers and Sisters, respectively, in order to develop tables for comparison.

Table 2. Expectations of life in years at specified ages, Brothers and Sisters, and native white males and females of the United States death registration states,[1] with ratios of female to male expectancies, for the period 1900–1954.

Group	Ages							Period
	15	25	35	45	55	65	75	
E.G.M.	54.00	44.80	35.62	26.71	19.09	12.27	7.14	1900–54
E.G.F.	56.58	47.75	39.35	30.75	22.45	14.78	8.92	
Ratio	1.05	1.07	1.10	1.15	1.18	1.20	1.25	
U.S.M.	51.80	43.09	34.41	26.08	18.57	12.23	7.47	1900–53
U.S.F.	55.12	46.34	37.82	29.34	21.27	14.07	8.41	
Ratio	1.06	1.08	1.10	1.13	1.15	1.15	1.13	

Standard error of $\mathring{e}_{15}$(E.G.M.) is .574. Standard error of $\mathring{e}_{15}$(E.G.F.) is .221.
Standard error of $\mathring{e}_{45}$(E.G.M.) is .569. Standard error of $\mathring{e}_{45}$(E.G.F.) is .202.
Standard error of difference between $\mathring{e}_{15}$(E.G.M.) and $\mathring{e}_{15}$(E.G.F.) is .615. Z is 4.20. P is less than .001.
Standard error of difference between $\mathring{e}_{45}$(E.G.M.) and $\mathring{e}_{45}$(E.G.F.) is .605. Z is 6.61. P is less than .001.

[1] United States rates for 1950–1953 are for white, not native white persons.
Sources: For Brothers and Sisters: The Differential Mortality of the Sexes, p. 126.
For United States population: Life tables developed from native white rates of United States population of Death Registration States as described in Table 3, weighted for each decade and age group, by sex, according to the proportion of the number of person-years lived by each experimental sex group in each decade and age group to the total person-years lived by that sex in that age group, 1900–1954. These tables are given in The Differential Mortality, pp. 249–252.

Such pooling gave more stable death rates; they were based on totals of 788 deaths and 130,863 person-years of life for Brothers, and of 6,144 deaths and 718,435 person-years of life for Sisters. The resulting expectations of life are set forth in Table 2.

When expectations of life at age 15 and at age 45 were tested, the advantages of Sisters in both cases proved significant at beyond the .001 level. Thus the first research hypothesis, that biological factors mainly underlie the differential death rates, was supported. It is interesting to note in this connection that in Table 2 the ratios showing Sisters' advantages became larger at each successive age interval—exactly the opposite of what would be expected under the sociocultural hypothesis. A somewhat similar trend appears in the ratios for the national population.

Analysis of Results by Age-Specific Death Rates[13]

We now turn our attention to the second research hypothesis, that not only are sociocultural pressures less important than biological factors in relation to the mortality differentials of the sexes, but they are of comparatively small importance in this respect. This hypothesis was examined by means of age-specific death rates.

A point of interest in regard to Table 3, which presents these death rates, is the spatial location of rates which favor Brothers over Sisters. If one imagines a rectangle enclosing the first three age groups, ages 15–44, and the first four decades, 1900–1939, he will discover that within this rectangle the rates of Sisters are higher than those of Brothers ten times out of twelve, 83 per cent. On the other hand, outside of this rectangle, he will discover that the Sisters are favored twenty-eight times out of a possible thirty-two, while Brothers' rates were lower only three times. In other words, 77 per cent of all rates unfavorable to Sisters are found within these early ages during the period 1900–1939. On the other hand, Sisters showed a

[13] The fractions upon which these rates were based will be found in the writer's dissertation, The Differential Mortality, pp. 225–253.

Table 3. Specific death rates per 1,000 persons for Brothers and Sisters and native white males and females of the United States death registration states,[1] by age group and sex, 1900–1954.[2]

Period	Ages								
	Group	15–24	25–34	35–44	45–54	55–64	65–74	75–84	85 and Over
1900–09	E.G.M.	4.96	8.10	7.30	18.34	18.97	(0/44)	—	—
	E.G.F.	7.20	9.63	7.94	9.70	19.26	44.75	*126.32*[b]	—
1900–10	U.S.M.[a]	5.1	7.65	10.05	13.9	25.5	55.9	127.45	264.2
	U.S.F.	4.95	6.98	8.3	11.7	21.35	47.6	114.65	252.6
1910–19	E.G.M.	4.49	6.55	5.07	13.64	15.14	50.63	*216.22*	—
	E.G.F.	5.78	8.07	6.82	9.86	16.22	45.87	91.74[e]	*97.56*
1910–20	U.S.M.	4.9	7.56	9.4	13.54	24.9	54.55	123.95	253.4
	U.S.F.	4.4	6.4	7.52	10.9	21.1	48.0	113.8	244.45
1920–29	E.G.M.	2.68	3.00	2.93	8.31	24.87	65.83	[illegible]1	—
	E.G.F.	2.63	4.64	5.92	7.38	16.93	43.24	94.43	256.88
1920–30	U.S.M.	3.3	4.3	6.64	11.45	24.0	54.15	120.1	242.45
	U.S.F.	3.2	4.4	5.94	9.7	19.95	46.45	109.6	233.3
1930–39	E.G.M.	0.66	1.11	4.73	11.72	24.19	48.55	132.04	(9/13.5)
	E.G.F.	1.03	2.39	4.23	7.58	15.14	37.25	90.94	222.22[d]
1930–40	U.S.M.	2.5	3.4	5.6	11.4	24.65	54.2	121.35	251.65
	U.S.F.	1.95	2.9	4.35	8.1	17.4	42.4	105.7	229.0
1940–49	E.G.M.	0.55	0.98	3.06	8.08	21.08	43.36	104.59	*255.81*
	E.G.F.	0.39	0.86	2.00	5.10	10.95	34.36	88.25	217.21[e]
1940–50	U.S.M.	1.75	2.35	4.4	10.45	23.65	50.3	113.05	243.4
	U.S.F.	1.05	1.65	2.95	6.25	14.0	35.0	92.75	211.85
1950–54	E.G.M.	0.44	0.60	2.16	8.18	16.74	47.06	106.48	*245.61*
	E.G.F.	0.01	0.60	1.56	3.67	8.54	24.56	74.92	191.89[f]
1950–53	U.S.M.	1.6	1.8	3.7	9.7	23.0	48.3	105.1	209.7
	U.S.F.	0.7	1.1	2.3	5.3	12.5	31.6	84.1	191.0
1900–54	E.G.M.	1.63	2.04	3.67	10.58	20.82	49.71	119.48	317.65
	E.G.F.	2.26	3.66	4.06	6.50	13.09	35.26	85.64	204.15
1900–53	U.S.M.	2.73	3.44	5.63	11.39	24.11	52.20	114.28	233.42
	U.S.F.	2.43	3.52	4.56	7.83	16.31	38.84	95.18	205.94

[1] Rates for white, rather than native white persons were used for the years 1950–1953.

[2] Rates for United States populations were computed by interpolating between rates for census years to secure a decade average. Results for ages 15–54 were corrected for the three decades 1900–1909, 1910–1919, and 1920–1929 by a factor obtained by forming a ratio between the average of yearly rates for the general white population for these years (in each decade) and the rates for the general white population after interpolation between census dates. Where interpolation had produced two decimal places, these places were both retained not to magnify the original rounding error.

[a] United States rates are for the expanding Death Registration States.

[b] *Italicised* rates are based on less than fifty person years.

[e] The Brothers' rate for this age group was based on deaths and person years for ages 75–79 only. Accordingly, in forming the ratio of Table 4, and in the life table for 1900–1954, the corresponding five-year rate of Sisters was used, viz. 73.56.

[d] For similar reasons, in forming the ratio of Table 4, and in the life table for 1900–1954, the five-year rate for ages 85–89 was used, viz. 204.35.

[e] For similar reasons, in forming the ratio of Table 4, and in the life tables for 1940–1949, and for 1900–1954, the Sisters' rate for ages 85–94 only was used, viz. 215.92.

[f] For similar reasons, in forming the ratio of Table 4, and in the life tables for 1950–1954, and for 1900–1954, the Sisters' rate for ages 85–99 only was used, viz. 190.77.

Sources: 1. For United States' rates, native white and white, respectively, 1900–1940: United States Bureau of the Census: Vital Statistics Rates in the United States, 1900–1940. Prepared by Forrest E. Linder and Robert D. Grove. Washington, United States Government Printing Office, 1943, Table 9, p. 186.

2. For United States' native white rates, 1950: United States National Office of Vital Statistics, Vital Statistics for Native White Males and Females (unpublished table, United States National Office of Vital Statistics, n.d.).

3. For United States' white rates, 1950–1953: United States National Office of Vital Statistics, Vital Statistics of the United States, 1953, Vol. I. Washington, United States Government Printing Office, 1956, Table AK, p. xlvi.

4. For United States' yearly white rates, 1900–1929, ages 15–54 (used in correction factors): United States National Office of Vital Statistics: Death Rates by Age, Race, and Sex: United States, 1900–1953: All Causes, Vital Statistics, Special Reports, Vol. xliii, 1956, pp. 14–15.

5. For United States' native white rates, 1900–1953: the decade rates, and the rates for 1950–1953 as shown in the table above. Each decade age-group death rate of males was weighted according to the proportion of the total person-years lived by Brothers in that decade age group. Females were similarly treated by weighting them to the distribution of Sisters' person-years.

6. For Brothers and Sisters' rates: The Differential Mortality of the Sexes, pp. 136–138, and p. 128.

clear advantage from age 45 upwards in all decades, and at all ages after 1939.

This finding supports the conclusion already reached in studying expectations of life that sociocultural pressures are not the main factors underlying sex differences in death rates, because it shows that Sisters enjoyed more favorable rates than Brothers at the crucial middle and older ages. It also indicates that Sisters' death rates at ages under 45 in the period 1900–1939 were anomalous. Analysis of the table for these ages and years makes it clear that Sisters' rates therein were at times exceptionally high. Since social pressures and degenerative diseases would hardly cause such high death rates between ages 15 and 24, and between ages 25 and 34, the conclusion seems warranted that some infectious or contagious disease or diseases plagued young Sisters in the early part of this century with unusually lethal effects.

A number of reasons suggest that this disease was tuberculosis. First, there was the greater difficulty of detecting incipient cases during the first quarter of the century in the medical examination required of candidates for admission, due to the less frequent use of X-ray pictures. Even in 1936, according to Dr. Frost, a large proportion of tubercular cases in the general public were not discovered until they had reached an advanced stage.[14] We may be fairly sure that the same would be true among Sisters in regard to those incipient cases of tuberculosis which had escaped detection at time of entrance. Secondly, the dangers of infection would be multiplied by the close life of the Sisters among themselves in the Convent, and the lack of general understanding then prevalent of prophylactic methods to prevent the spread of the germ. "Age and prior exposure bring no such immunity against tuberculosis as they establish against many of the acute infections."[15]

[14] Frost, Wade Hampton: How Much Control of Tuberculosis. *In* PAPERS OF WADE HAMPTON FROST, M.D. Ed., Kenneth F. Maxcy, M.D. New York, Commonwealth Fund, 1941, p. 607.

[15] Frost, Wade Hampton: The Age Selection of Mortality from Tuberculosis in Successive Decades. *In* PAPERS OF WADE HAMPTON FROST, p. 594.

Again, the highest tuberculosis mortality of cohorts of birth appears to occur between ages 20–29.[16] Moreover, it has been a fairly common observation that females between ages 10 and about 29 show higher susceptibility to tuberculosis than males of these ages, so much so, indeed, that in 1929 Sydenstricker called such women "relatively neglected groups" and found their death rates from tuberculosis were 59 per cent higher than the male rate at 10–14 years of age, 106 per cent higher at 15–19 years, and 43 per cent higher at 20–24 years.[17]

Finally, Fecher's work[18] as well as the British experience of 1930–1932[19] makes it evident that Catholic Sisters and nuns aged 15 to 34 years during the period 1900–1932 had rates of tuberculosis which were unusually high and which were far above the rates for single women. Single women at these ages generally showed rates higher than those of married women or of males. Dr. Taylor found similar results among Sisters in three American communities she studied from their foundation in the last century up through 1953.[20]

Ratios were formed from the values shown in Table 3 by dividing Brothers' death rates by those of native white males, and Sisters' death rates by those of native white females. In order not to bias the comparison, each ratio was weighted by the number of person-years out of the total that Brothers or Sisters had lived in the particular decade-age-group, and thus average weighted ratios were formed for ages 15–44, ages 15 and above, and ages 45 and above.

These average ratios show whether Brothers made greater gains over native white males than Sisters made over native

[16] *Ibid., American Journal of Hygiene,* 1939, XXX, Sec. A, p. 91, footnote (in letter of Dr. Frost to Dr. Sydenstricker, quoted.)

[17] Sydenstricker, Edgar: Tuberculosis Among Relatively Neglected Groups. TRANSACTIONS OF THE NATIONAL TUBERCULOSIS ASSOCIATION, 1929, XXV, p. 268.

[18] Fecher, Constantine J.: THE LONGEVITY OF MEMBERS OF CATHOLIC RELIGIOUS SISTERHOODS. Washington: Catholic University of America, 1927, pp. 42–44. Fecher is at present bringing his interesting study up to date.

[19] Registrar General's Office, THE REGISTRAR GENERAL'S DECENNIAL SUPPLEMENT, ENGLAND AND WALES, 1931. Part IIa. Occupational Mortality. London, His Majesty's Stationery Office, 1938, Table 4c, p. 303.

[20] It is the writer's understanding that Dr. Ruth Taylor and Mr. Ben Carroll of the National Institutes of Health expect to publish these results in the near future.

white females and vice versa. Thus they permit comparison of the differences of patterns between sexes in death rates for the "experimental" groups and for the national population. Where the ratios are equal, this shows that the patterns between sexes of the national groups are perfectly reflected in the differential rates of Brothers and Sisters. However, where male ratios are lower, this indicates that Brothers have made greater gains, and that there has been convergence between death rates of Brothers and Sisters, when these are measured from the positions of male and female of the national population. On the other hand, where female ratios are lower, it indicates Sisters have made greater gains, and that there has been divergence.

We may again ask, what results would lead to the non-rejection of the second null hypothesis, that sociocultural factors are of more than small importance in effecting the sex differences in mortality rates? Taking into account the lower accident rates of younger Brothers, and the less hazardous and stressful occupation in which they are engaged in comparison with that of the average native white male, as well as the fact that young Sisters are probably under greater stresses than the average native white female, non-rejection of the null hypothesis would call for large divergences from the patterns of the

Table 4. Average weighted ratios of Brothers' death rates to death rates of United States' native white males, and of Sisters' death rates to death rates of United States' native white females, for ages 15–44, 15 and all ages over, and 45 and all ages over, 1900–1954.[1]

Group	1900–09	1910–19	1920–29	1930–39	1940–49	1950–54	1900–54	Ages
Brothers[2]	.94	.84	.73	.36	.44	.36	.61	15–44
Sisters	1.26	1.18	.97	.80	.55	.44	.96	
Brothers	.97	.85	.77	.45	.50	.44	.66	15 and
Sisters	1.18	1.09	.93	.83	.66	.56	.92	Over
Brothers	1.13	.87	.96	1.00	.83	.84	.92	45 and
Sisters	.85	.86	.82	.90	.85	.71	.84	Over

[1] The United States rates for 1950–1954 used were for the white rather than the native white population.

[2] "Brothers" was used here as a shorthand expression for the death rates of Brothers divided by the death rates of United States native white males and weighted according to the number of person years of exposure; similarly "Sisters."

Source: The Differential Mortality of the Sexes, pp. 169–171, and p. 173.

general public which would (a) be particularly manifested during the crucial middle and old-age periods of life, and (b) which would be in the direction of convergence between Brothers and Sisters' death rates, rather than in the direction of greater divergence.

The results shown in Table 4 do not present a picture of convergence of Sisters' death rates towards Brothers nor divergence from the general public pattern of superior female death rates at the middle and the old ages. An examination of this table reveals that Sisters exhibited as much superiority over Brothers at these ages as females over males of the general public. Almost all comparative gains of Brothers occurred at ages 15–44, a period in which it is difficult to believe that the underlying causation could have been influenced much by social stress and strain. Rather the difference, particularly in the last fifteen years of observation, appears due to gains of Brothers over native white males in lower death rates from motor vehicle and other types of accidents, on the one hand, and on the other to high death rates from infectious disease such as tuberculosis among Sisters in the first quarter of this century.

Tests of significance were made by weighted analyses of variance upon each of the values shown in Table 4.[21] Brothers' ratios proved significantly lower than Sisters at ages 15–44 in the 1900, 1910, and 1950 decades, and for the period 1900–1954 (at .05 for each period, except 1910–19 when the difference was significant at .001). In the decades 1920, 1930, and 1940 the differences were not significant.

At all ages, 15 and above, Brothers' ratios proved significantly lower in the 1910, and the 1930 decades, as well as in the period 1900–1954. (The level of significance was .01 except for 1930 when it stood at .05.)

At ages 45 and above, no differences were significant within decades, but the Sisters' lower ratio for the entire period 1900–1954 was significant at the .01 level.

[21] The Method of Fitting Constants was used to obtain adjusted sums of squares for sex and for age. *Cf.* Snedecor, George W.: STATISTICAL METHODS. Ames, Iowa, Collegiate Press, 1946, pp. 296–99.

Probably the Brothers' lower ratios at ages 15–44 would have been significant more often if more degrees of freedom had been available than the one and two present in each decade for sex differences, because the F scores were high. However, the number of degrees of freedom for ages 15 and above (all ages studied) ranged from one and five to one and seven.

Since there were no large departures among Brothers and Sisters at the middle and older ages from the patterns of female superiority observed in the general public and since, in fact, at these ages Sisters' ratios were generally somewhat lower, the null hypothesis was rejected and the research hypothesis, that sociocultural pressures made only small contributions to the differential mortality rates of the sexes, was supported. Because of the nature of the tests, it was not possible to set any precise level of probability for this rejection of the null hypothesis.

Evaluation of Results

The finding that biological factors played by far the chief part in differentiating the death rates of members of the universe studied is very important. Since these members were native white Americans of sufficient health to be admitted into religious communities engaged in the active occupation of teaching, the results point to the operation of similar biological factors as the chief agents in the differential death rates of the two sexes of the American general public.

An interesting lead for further research is the notable, even spectacular improvement of young Sisters under observation from the early to the late years of the study. From showing the poorest records of the four populations compared in the period 1900–1909, they improved rapidly to exhibit by far the best mortality records for the years after 1939. This suggests the hypothesis that *under conditions of equal stress* women may be no more resistant to the *infectious* and *contagious* diseases than men—perhaps even less so—and that the gains which women have been making over men in this century may

be chiefly bound up with a greater constitutional resistance to the *degenerative* diseases. This would account for the remarkable improvement of young Sisters vis-a-vis the other three populations, because of the spectacular advances made during this century in controlling the ravages of the infectious and contagious diseases. If this hypothesis is borne out by further research, one might then say that the growing advantage of American women over men is a function of the transition from conditions when infectious and contagious diseases were the main causes of death to conditions wherein the degenerative diseases play this role.

Of course, an alternative hypothesis is possible. There may have been some hidden selection of Sisters in the earlier quarter of the century which operated at a much reduced degree in the second quarter. What this selection would be is obscure. None of the convents took in girls to "let them die in the religious life." Nor was the ascetical life of the Sisters apparently more rigorous than that of the Brothers, although both regimes were more severe at the start of the century than they are now. Further, the physical examination of candidates for admission seems to have been more careful than that of the Brothers rather than less painstaking.[22]

The continuing phase of this study[23] should allow some test of these hypotheses, as well as the hypothesis that the chief reason for the poor showing of young Sisters during the first quarter century was tuberculosis. However, it is hoped that the results of the present study will stimulate further research by other interested parties, including both replications of the present study among other matched groups of men and women, and medical research, first, into causes of death which carry off

[22] The writer learned these facts from a questionnaire which he circulated among the communities in his sample after the results had become available.

[23] In this further phase, causes of death will be analyzed for the Brothers and Sisters of the study. Dr. Rupert B. Vance of the University of North Carolina and Mr. William Haenszel and staff of the National Cancer Institute are collaborating with the writer in this extension of the study. Place of death is being secured from the communities in the sample, and the various state vital statistics offices will be searched for the death certificates.

more men than women when social stress differentials have been minimized, and, secondly, into specific biological factors which may be associated with the longer life of women. Such studies may advance the date when our men can enjoy an average lifetime as long as that of women.

A NOTE ON BIRTH AND DEATH REGISTRATION OF MILITARY DEPENDENTS

ROBERT N. BISHOP[1]

RESIDENCE allocation of certificates of birth and death to military dependents are a source of error in resident infant and neonatal death rates and in resident birth rates. This conclusion issues from an inquiry of the reason for substantial differences between the occurrence and the residence infant death rates of Pierce County, Washington State. Pairs of rates for the past five years are as shown in Table 1. All resident rates since 1951 are seen to be larger than corresponding occurrence rates.

Explanation of the difference in rates in terms of a difference in viability between infants born to Pierce County residents, and those born in Pierce County to non-residents, seemed impossible. The explanation therefore was sought in the registration procedure; in particular, in the procedures of the two armed service hospitals of the County. Certificates of birth and infant death issuing from the two hospitals in 1954 were each tabulated by the categories "Pierce-County Resident," "Resident of other County of Washington" and "Resident of other State." The results are shown in Table 2.

The two distributions agree fairly well in their proportions falling in "Other County of Washington," but are markedly different in the "Pierce County" and "Other State" categories. Fifty per cent of the births in the two hospitals are registered as occurring to mothers resident out of state. Only 6 per cent of the infant death certificates show out of state residence.

We have the strong suggestion that deceased infants whose mothers are described as residents of an "other state" on the

Table 1. Infant death rates, Pierce County, Washington.[a]

	1951	1952	1953	1954	1955
Occurrence Rate	28.6	27.6	24.0	24.3	25.8
Residence Rate	28.3	28.8	27.5	29.0	33.0

[a] Washington Vital Statistics, Summary, years 1951 through 1955.

[1] Statistician, Tacoma-Pierce County Health Department.

Place of Residence Shown on Certificate	Births (Jan.–June)		Infant Deaths (Jan.–Dec.)	
	Number	Per Cent	Number	Per Cent
Pierce County	492	39	53	82
Other County of Washington	129	10	8	12
Other State	633	50	4	6
Total	1,254	100	65	100

Table 2. Vital occurrences at two armed service hospitals, Pierce County, Washington, 1954.

birth certificate, generally are themselves described as residents of Pierce County on the death certificate. We take this to be the fact. An error is thereby produced in the resident infant death rate, for it is the assumption of the rate that resident infant deaths occur from among resident births.

The divergence of the mother's and infant's place of residence issues from the residence situation of the mothers. These are wives of armed service personnel stationed at Ft. Lewis and McChord Air Force Base. They generally reside in Pierce County, but only incidentally to the husband's military assignment. The place of "usual residence" named for the birth certificate tends, then, to be the home town or the place to which they expect to return upon the husband's military discharge. The place of "usual residence" named for a deceased infant tends, however, to be the mother's residence at the time of birth, and normally this is Pierce County.

Further, the difference in distribution by place of residence, of births and infant deaths occurring in the two hospitals, does account for the difference between the 1954 occurrence and resident infant death rates of Pierce County. Thirty-nine per cent of births in the Armed Services Hospitals (based on a six-months' sample) were resident of the County (Table 2). In 1954 a total of 65 infant deaths occurred in the two hospitals, 39 per cent of which is 25, the expected number of resident infant deaths should the place of residence shown on the birth and death certificates always agree. Fifty-three of the 65 infant death certificates actually indicated Pierce County residency, an excess of 28 over the expected number. Total resident births

of the County (1954) were 6,129 and total resident infant deaths 178. Reduction of the 178 by 28 gives a resident infant death rate of 24.5, very close to the occurrence rate of 24.3. We assume differences between the remaining pairs of rates to be likewise accountable.

A registration rule sufficient to eliminate the described error in the resident infant (and neonatal) death rate must produce agreement between mother's residence as shown on the birth certificate and infant's residence as shown on the death certificate. Current Federal registration rules (PHYSICIAN'S HANDBOOK ON DEATH AND BIRTH REGISTRATION, 10th Edition) make no such requirement. We are informed, however, by George Ormrod, State Registrar of Washington, that it is an accepted principle of registration that the residence of an infant is the residence of the mother. The 9th Edition of the PHYSICIAN'S HANDBOOK states: "When the deceased is an infant, give usual residence of the mother." A 1947 memorandum from the office of the Washington Registrar states: "Infants and children have the same residence as their parents. In the case of death of a newborn infant, its usual residence is the residence of its mother and not necessarily the place of birth or death even though as a living being it had never been in its mother's residence."

The principle above is quite clear and if observed in registration practice produces a valid infant death rate. However, it has tended not to be observed among displaced military dependents of Pierce County. The possibility that the consequent registration problem is general to other areas housing concentrations of military dependents is the basis of this article.

A conventional manner of meeting the problem is through matching all certificates of infant death with certificates of birth, correcting such death certificates as show a differing place of residence. An alternate policy is to require that birth certificates of military dependents show mother's current residence as the place of usual residence. Agreement of residence between certificates of birth and death is then a more or less automatic consequence of the habit of naming mother's current residence as the usual residence of the decedent infant. Should births always, or nearly always, occur at a military hospital,

the policy may be implemented simply by a request that the hospital put the policy in effect.

It may be objected that a current place of residence due to the husband's military assignment is not necessarily the place of "usual" residence. Appeal to the Federal registration rules does not decide this question, the term "usual residence" being amplified only by the circular definition: "Where the child's mother usually lives." We are inclined to believe that a current residence which may last or have lasted a good part of a twenty-four month draft period may reasonably be considered the "usual residence." In this usage we are supported by policy of the Federal Census which does count military dependents as residents of the place where they currently reside.

The second described policy is not merely an expedient for avoiding cross matching of birth and death certificates. Its primary advantage over the first is that correction is also made of the resident birth rate. Computation of birth rate requires consistency between policy for determining the residence of births and policy for determining the residence of the population. As Census enumerations count military dependents as resident of the place they currently live, births to military dependents should be enumerated likewise.

It is desirable to maintain consistency between registration policies of the different registration areas. The National Office of Vital Statistics should therefore be encouraged to publish a decision on the above matters.

ANNOTATIONS

SURVEY DESIGN AND ANALYSIS[1]

THIS textbook is much more specialized than the title indicates. For the most part it selectively treats the analysis problems of opinion surveys. The focus is on training "analysts." These are the specialists on research teams who analyze the data but who do not necessarily either plan the survey or supervise collection of the data. The author has worked in close collaboration with the Columbia University Planning Project for Advanced Training in Social Research. One reflection of this fact is his extensive use of case materials.

The text is organized into four parts. The first part discusses "the institutional setting within which the analyst works." The large survey of today requires that the analyst use mass assembly methods and that he belong to a large research organization, which itself must seek sponsorship and subsidy. Hyman reviews some of the negative consequences of this setting such as problems of communication, excessive specialization, and conflicts over goals, methods, deadlines, and areas of responsibility.

A distinction is made between "descriptive surveys" which do not involve the study of relationships and "explanatory surveys" which do. The main problems of the descriptive survey, covered in Part II, are (1) adequate conceptualization and operational definition; (2) selection of the most "relevant" population; and (3) reduction and allowance for "response error." The distinctive problem of explanatory surveys is analyzing relationships. Procedures for this are considered in Part III.

[1] Hyman, Herbert: SURVEY DESIGN AND ANALYSIS. Glencoe, Ill., The Free Press, 1955, xvii + 425 pp., $7.50.

Part IV, shorter than the others, sketches a few problems in the utilization of survey results. Most of one chapter is devoted to ways in which the opinion polls might meet some of the criticisms publicly leveled against them. In the next chapter the student is cautioned against excitement over a cross-tabulation unless the subgroups differentiated are in some way important or manipulatable. Sewell's testing of psychoanalytic theory is used to illustrate the difficulties of validating or invalidating a "discursive system" of theory.

Actually the content of Part III is the most original and merits fuller description. Analytical procedures are described which make wholesale use of subgroup comparisons. These procedures originated in work reported in THE AMERICAN SOLDIER. Since then several persons from the Columbia group have sought to develop a formal rationale for these procedures by distinguishing three modes of analysis, all involving the use of subgroup comparisons. Hyman and Patricia Kendall summarize this rationale in Chapter 7.

The three modes of analysis may be roughly illustrated as follows. A relationship is observed between college attendance (versus nonattendance) and later economic success. Is college attendance a genuine or spurious determinant of economic success? If spurious, then it should be possible to "wash out," or substantially reduce, this relationship by holding constant factors "extrinsic" to college attendance, such as income or occupation of father. That is, it should be possible to subgroup the total sample of college attenders and non-attenders by income or occupation of father and show that within these subgroups the original relation between college attendance and later economic success largely disappears. Typically an extrinsic factor which can explain away a relationship in this manner proves to be antecedent to the spurious determinant, just as parental occupation and income is antecedent to college attendance. On the other hand, if college attendance is a genuine determinant, then its relationship with later economic success will tend to persist within successive applications of extrinsic controls. This process of testing the genuineness of a relationship is called "explanation." There is no formal solution to the number of extrinsic factors that must be tried before accepting the

determinant as genuine. However it is felt that a thorough analysis can be distinguished from a superficial one.

Suppose that college attendance is accepted as a genuine determinant of later economic success. Then there are two broad ways to explore this relationship further. First, one may repeat the procedure above, using as controls, not factors extrinsic to college attendance, but factors integral to it or part of the same complex, such as occupational skills learned at college or contacts made there. By observing how much the relationship between college attendance and later economic success is lowered when this or that aspect of college life is held constant, one hopes to learn more about the "links" or "intervening variables" through which college attendance affects later economic success. Typically these "intervening variables" also intervene in time between determinant and effect. This mode of analysis is called "interpretation." Of course, the division between factors "extrinsic" to college attendance and integral to it, or part of the same complex, is a matter of definition and arbitrary. However several researchers working on the same problem can usually be expected to achieve a large measure of consensus.

Secondly, the economic advantage of college attendance may vary for different segments of the population. Accordingly one might classify the total sample by such factors as race, region, sex, or decade of attendance, observing how the strength of the relationship between college attendance and later economic success varies among the different subgroups. This mode of analysis is called "specification."

In all three modes of analysis the basic tool is the same—subgroup comparisons. In the first two instances the level of relationships within subgroups is compared with the original relationship taken over the entire sample. Thus the distinction between "explanation" and "interpretation" depends on the purpose of the analysis and usually too on the time sequence of determinant, "test factor," and effect. In the case of "specification" the relationships within subgroups are compared with each other, rather than with the original relation taken over the entire sample.

Throughout the book, Hyman's long experience in survey

work is obvious in the soundness of the points which he chooses to make and in his capacity to illustrate them with interesting examples. Nevertheless it must be questioned whether Hyman has produced a useful text on survey methods. The book has several serious deficiencies.

In the first place, the title SURVEY DESIGN AND ANALYSIS greatly overstates the ground covered. Such things as survey planning, sample design, schedule preparation, interviewer training and supervision, editing, coding, and punching are not treated. Nor are the relationships between these activities and the analysis phase systematically discussed. In particular, the consequences of sample design for analysis are ignored. Even the treatment of the analysis phase is very incomplete, being confined to a specialized set of procedures without any attempt to relate them to statistical theory.

There are pedagogical deficiencies too. The style of writing is bombastic. The ratio of abstract discussion to case materials is high in particular sections. Practice problems are offered but they are too few to represent more than a gesture.

By far the most serious deficiency, however, is a complete disregard of statistical theory. The result is that many of Hyman's discussions, if not unsound, are at least very incomplete. For example, when discussing the choice of a "relevant" population, nothing is said about having to accept a less relevant population in order to achieve an efficient sampling design, or perhaps even to attain probability sampling at all. In all his references to error and its multiple sources, no mention is made of the crucial distinction between sampling error and bias, with one of these types of error sensitive to sample size but not the other. In the section on utilizing survey results, he passes over the problem that any opinion poll, asked to collect data and make a choice between two predictions, runs a high risk of choosing the wrong alternative whenever the true division in the population is of a certain character. Thus, for example, regardless of research design, the pollster runs essentially a 50 per cent chance of being wrong about an election if the popularity of the two candidates is nearly equal.

The disregard of statistical theory is most damaging in the section concerned with the analysis of relationships. A certain

proportion of the time, sampling fluctuations will yield samples in which the relationships between a control factor and the independent and dependent variables are grossly unrepresentative of what they are in the population. This means a risk that a spurious determinant will not "wash out" when it should, as well as the converse risk that a genuine determinant will wash out even though it should not. Of course analogous risks arise in the analyses being called interpretation and specification. Unless these risks are known approximately, the results remain ambiguous and uncertified, however plausible. Hyman offers no techniques for estimating these risks. Nor is the point made that without probability sampling these risks cannot be estimated; and furthermore, that unless the sampling design is of a particularly simple sort, the estimates of these risks are much more difficult to calculate for subgroups than for the entire sample. Hyman acknowledges that the wholesale use of subgroup comparisons is often complicated by case attenuation and by "imprecision of control" (when a continuous variable is dichotomized or trichotomized in order to serve as a control). All the examples he gives have large enough samples and clear enough results so as to minimize these problems. But nothing is said about what to do in the more common case where small sample size or weak relationships render impractical an exclusive reliance on subgroup comparisons.

ROBERT G. POTTER, JR.

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IMMIGRANTS AND THEIR CHILDREN, 1850–1950[1]

HUTCHINSON'S IMMIGRANTS AND THEIR CHILDREN, 1850–1950, is a 1950 Census monograph. It is a namesake of Carpenter's earlier Census monograph on this subject. As described by Hutchinson:

> A summary of census information on the foreign stock, up to and including the Census of 1920, is provided in the 1920 Census

[1] Hutchinson, E. P.: IMMIGRANTS AND THEIR CHILDREN, 1850–1950. New York, John Wiley & Sons, Inc., 1956, 391 pp. $6.50.

monograph by Niles Carpenter, *Immigrants and Their Children.*[2] The present monograph continues the summary up to the most recent census, describing changes in the size, composition, and geographical distribution of the foreign stock from 1920 to 1950; but deals more particularly with occupational data for the foreign stock, a body of census material not covered in detail by Carpenter. (p. 268.)

Hutchinson first describes the general trend of the foreign stock during the past century. (Chapter 1.) He reminds us that census data on the foreign born were first available from the 1850 Census. The changing composition and geographical distribution since 1920 are then discussed in Chapters 2 and 3. The characteristics considered are country of birth and parentage, ratio of first to second generation, age, and sex ratio. Except for the conclusions, the remaining chapters (4–10) are devoted to occupational characteristics and occupational distribution of the foreign born and foreign stock.

Chapter 4 describes some of the occupational characteristics of the foreign stock by country of origin and discusses the nature of occupational data on the foreign stock available for each census since that of 1870 when such data were first reported separately for the foreign born. The question of comparability of occupational groups since 1870 is raised. On this matter the author is wisely guided by Alba M. Edward's earlier study, COMPARATIVE OCCUPATION STATISTICS FOR THE UNITED STATES, 1870 TO 1940. He finds that elements of incomparability may be introduced by changes in classification and by changes of occupations themselves. "Comparison over time is also impeded by the change of the classification of occupations from a predominantly industrial basis in 1870 to 1900 inclusive to a more fully occupational basis thereafter. . . . For 1900 and earlier years, therefore, comparisons from one census to another are more in terms of major occupational groups than for specific occupations; and, because of the irregularity of the data from census to census and the predominantly industrial classification, it has seemed sufficient to review rather briefly the occupational data for these earlier years in order to provide background data

[2] Carpenter, Niles: IMMIGRANTS AND THEIR CHILDREN, 1920, Census Monographs VII, Washington, Government Printing Office, 1927, 431 pp.

for the more recent material. . . . Fortunately, the occupational data from 1910 onward constitute a more uniform series, and permit classification of workers according to their position or occupational status. The 1910 and 1920 occupational data are accordingly regrouped to conform to the abbreviated occupational classification available for 1950 with some adjustment for changes in classification procedure." (pp. 75 and 76.)

Accordingly, the author does not attempt to discuss trends in the occupational characteristics prior to 1900 except in a very general way. Instead he writes four rather self-contained chapters (5–8) on the occupational distribution of the foreign born or foreign stock in 1870, 1880, 1890, and 1900, respectively. In each case he discusses the distribution by major occupational group, distribution by detailed occupational group, country of origin and detailed occupation, and occupational concentration or dispersion of the foreign born. The reading becomes rather tortuous before these four chapters are completed. The pace quickens, however, in the chapter (9) on trends in occupational distribution during 1910–1950.

The findings can be summarized only in very broad terms in this review. In 1850 there were about 2.2 million foreign born in this country and they constituted 9.7 per cent of the population. In so far as census years are concerned the peak in the number of foreign born was reached in 1930 when 14.2 million were enumerated. However, the peak in the "per cent foreign born" (14.7 per cent) was reached in 1910. In 1950 the foreign born numbered 10.3 million and they comprised only 6.9 per cent of the total population.

Besides a marked reduction in the number and per cent of the foreign born in this country, there has been a shift of origins. Since the enactment of the immigration restriction legislation in the 'twenties there has been a marked increase in the proportion of our immigrants that come from the Western Hemisphere. The rapid aging of the foreign born population has followed rather automatically the marked reduction in the stream of immigration. A marked decline in the sex ratio of the foreign-born whites is apparent. There were about 122 males per 100 females among the foreign-born whites in 1920 and 102 in 1950. The sex ratio varies widely by country of origin. Thus,

in 1940 the number of males per 100 females was 74 among the foreign-born whites from Ireland (Eire) and 298 among those from Bulgaria.

Traditionally, the foreign born in this country have been concentrated in large cities of the Northeast. They have been relatively rare in the South and especially in the rural South. The foreign-born whites of 1950 are even more highly concentrated in urban areas than were those of 1920. The urbanization of the population since 1920, of course, also applies to the natives.

Thirty years ago, the term "immigrant labor" was almost synonymous with "unskilled labor" in this country. Many of the immigrants were young adults just entering the labor force. Many of them had been reared in rural areas of Europe and had no special skills for urban employment. However, there has been a marked decrease in the proportion of unskilled laborers among the immigrants. According to the author, over half (54 per cent) of the immigrants during 1905–1914 were classified as "unskilled." The proportion was 31 per cent for the 1920–1929 immigrants and 16 per cent for the 1930–1939 immigrants.

The author finds that the proportion of professional workers tends to be higher among the English, Welsh, Scots, and French than among other foreign white stocks in the United States. The lowest proportion is found among the Mexicans, Yugoslavs, Greeks, and Italians. The Mexicans, Scandinavians, and Dutch have exhibited the highest proportions in agriculture. In terms of urbanization, the immigrants from Ireland, Poland, Russia, and Greece are most concentrated in cities and those from Mexico and Scandinavian countries are least concentrated in cities.

In the reviewer's opinion the repetition of Niles Carpenter's title, IMMIGRANTS AND THEIR CHILDREN, is somewhat misleading. A title including some variant of "occupation" or "labor force" would be much more indicative of the content of the book. Students who are particularly interested in occupational changes of the foreign stock, of course, will be glad that this subject is emphasized. Doubtless others will consider it unfortunate that the author made little or no use of a variety of census data that would have contributed to a better under-

standing of immigrants and their children. No use is made of previous data on mother tongue. No use is made of the data on educational attainment collected in 1940 and 1950. No use is made of census data on marital status or of data from other sources on intermarriage.

Despite these statements, the reviewer hastens to emphasize his belief in the value of this book. The author does provide excellent data on a variety of characteristics other than occupation. His measure of "relative concentration" by state of residence and by occupation is worthy of wider use. Those interested in trends in the occupational characteristics of the foreign born will be particularly indebted to Dr. Hutchinson for this work.

CLYDE V. KISER

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HEALTH AND DEMOGRAPHY[1]

HEALTH AND DEMOGRAPHY is a report which was originally presented at a seminar held by the Bureau of State Services of the Public Health Service on some of the population trends and developments which may have an impact on present and future health programs. A running commentary faces all of the forty-four charts which are organized in five major groups: (1) Dynamics of population trends in the United States, (2) Population trends for major geographic areas and states, (3) Population characteristics: age and marital status, (4) Population characteristics: economic, and (5) Indicators of health and disease.

Demography is the study of "the past, present and probable future of the population—in terms of total number, fertility and mortality trends, age and sex composition, occupation, mobility, and other measurable characteristics." Public health and demography are interdependent. Every population change affects public health just as public health programs affect the age-composition of the population.

[1] Dunn, Halpert L.: HEALTH AND DEMOGRAPHY. Public Health Service, United States Department of Health, Education, and Welfare, October, 1956, 94 pp.

The first section concerns the dynamics of population trends in the United States. Population change results from births, deaths, and net migration. Population in the United States has increased continuously since the first Census in 1790. The births have consistently exceeded deaths, life expectancy has increased steadily, and although immigration has become relatively unimportant in recent years it still exceeds emigration. Over 90 per cent of the population growth in the last two decades has resulted from natural increase, i.e., the excess of births over deaths. However, a study of trends in the birth rates for first, second, third and later children show sharp declines in all birth orders during the 1920's and early 1930's.

Age-adjusted death rates are shown for the four major groups by color and sex. Except for the peak in 1918, the death rates have steadily decreased, 50 per cent or more in each group. Death rates are consistently higher for nonwhites than for whites and for males than for females. Annual death rates are shown for each of eight age groups. The age groups under 45 show steeper declines in mortality than those at older ages. The average duration of life has increased over twenty years (from 43 to 64 years) since 1900. The white-nonwhite differences in average length of life have decreased while the male-female differences in average length of life have increased.

The second section of the report concerns population trends for major geographic areas and states. The world population of 545 million in the year 1650 doubled in size by 1850 and quadrupled by 1950. It is currently increasing by about 1 per cent yearly. North America has shown the most striking gain in size: from 1 million in 1650 to 150 million in 1950. While the rate of immigration has decreased, internal migration has caused great shifts in population distribution. A glance at the population growth by regions shows that the population in the West has increased more rapidly than in other sections of the country. Further breakdowns are shown by states, counties, and urban-rural status. Rapid urbanization is very evident. The effects of internal migration by states include redistribution not only of the total population but also of specific age groups. Persons in the 18–44 age group predominate in the migrating population. Changes in the Negro population are

evidenced between 1940 and 1950. There has been a general exodus of Negroes from the South, particularly the South Central States. The Negroes comprised 10.0 per cent of the total United States population in 1950.

The third section pertains to the population characteristics: age and marital status. Between 1900 and 1940 the percentage of people over age 40 increased and the relative number of children and youth decreased. In 1950, the nonwhite population and the rural population both had larger percentages of younger persons than did the white and urban populations. The proportion of persons 65 years of age and over has risen steadily, from 3.4 per cent in 1880 to 8.1 per cent in 1950 and is especially high in the New England and the West North Central States. It is interesting to note that the ratio of males to females in the aged group has decreased sharply since 1930. At ages 70 and over, more women are widowed than are married while the reverse is true for men. The increased expectation of life and the decline of the birth rate have been followed by an increase in the proportion of aged persons. The proportion dying at age 65 or over has increased from 13.8 per cent in 1880 to 56.5 per cent in 1955.

The economic population statistics are discussed in Section IV. In the 1940's, the male labor force increased as the male population of 14 and over increased, but the female labor force increased more than twice as much as the adult female population. The greatest increase for both sexes occurred in the Western States. By major occupation group, it is evident that the workers entered offices and factories and left the farms and private housework. Industrialization has been most rapid in the Western half of the United States although in 1950 the Northeastern quadrant was still the most highly industrialized part of the country.

The concluding section concerns indicators of health and disease: changing patterns in the causes of death, age-specific death and illness rates, infant mortality, and life expectancy. The leading cause of death changes from accidents below the age 25 to heart disease for the adult ages. Disabling illness is largely acute in the younger ages and chronic in the older ages. The mental and neurological diseases continue as the leading

cause of disability until old age when the chronic diseases take their toll. Trends of death rates show the decline as a cause of death of acute infectious diseases as tuberculosis, nephritis, syphilis, and rheumatic fever and the rise of noninfectious diseases as heart, diabetes, cancer, and stomach ulcer. Life expectancy during 1949–1951 was higher for the females than for the males (72.0 and 66.3, respectively).

Dr. Dunn concludes that with the growing conquest of communicable disease by eliminating the pathogen as in water sanitation, by eliminating the vector as in insect control, and by immunizing the potential host, we may next turn our attention to the kinds of diseases or lack of good health that are bound up with the social economic world in which people live and work. Many changes mentioned in the previous charts (urbanization, industrialization, aging population) are conducive to personal maladjustment and resulting illness. We need more research on the social environment and on health in the "normal" or fully fit individual.

MARGUERITE KELLER

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